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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Twenty-seventh Annual Meeting, New England Association of Gas Engineers.

OFFICE OF THE SECRETARY, LYNN, MASS., Jan. 20, 1897.

The twenty-seventh annual meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, on Wednesday and Thursday, February 17th and 18th, 1897.

The meeting will be called to order at 10 o'clock A.M., Wednesday, February 17th. A list of papers, whose subjects will be enumerated later, will be presented, in addition to which time will be set apart for discussion of questions from the "Question Box" and "Short Topics," to which all members are urged to contribute.

C. F. PRICHARD, Secretary.

[OFFICIAL NOTICE.]

February Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, Feb. 1, 1897.

The February meeting of the Society of Gas Lighting will be held in the Arena, No. 39 West 31st street, New York city, at 3 P.M., of the 11th inst.

FRED. S. BENSON, Secretary.

[OFFICIAL NOTICE.]

February Meeting, Guild of Gas Managers.

OFFICE OF THE SECRETARY, Feb. 2, 1897.

The February meeting of the Guild of Gas Managers will be held in Young's Hotel, Boston, Mass., at noon of Saturday, the 13th inst.

A. K. QUINN, Secretary.

BRIEFLY TOLD.

THE THIRTEENTH ANNUAL MEETING OF THE OHIO GAS LIGHT ASSOCIATION.—The only "unlucky happening" in connection with the Ohio Association's Thirteenth Annual Meeting was the weather condition that prevailed, but even that, during the actual sessions of the body, was not so distressing. Tuesday afternoon and evening, however, when the delegates and guests were arriving, Farmer Dunn greeted them with a mixed downpour of snow and sleet which was more than discomforting, for the temperature was just above the freezing point, and slush predominated. Before the night had found its way into morning, though, the skies were fairer, and all went well. Between the attractions of the Gas Exhibition and the meeting of the Association, magnetism of sufficient force had been developed to draw the gas men from almost every section of the country to the city. About 6 P.M. of Tuesday the corridors of the Fifth Avenue Hotel, which excellent house had been wisely selected for Association headquarters, were thronged with representative gas makers, and for once the "Amen Pew" did not command all the attention of the passing guest. Towards

9 P.M. the gas men were to be found in the Garden, inspecting and admiring the exhibits of the manufacturers, with their brave illustrations of things new and old to them and to their art. A good night's rest put everybody in good shape to attend the technical sessions of the first day, and President Penn, Secretary Lathrop and the Association as a whole had good cause for congratulation over their determination to hold the 13th session in New York. The attendance was excellent and representative, and the East responded in imposing manner, full two score of the Easterners being on hand to greet their Ohio brethren. The meeting room in the Garden, originally determined upon, after a trial for the first morning session not coming up to the requirements, was changed later for one that answered every purpose, and thereafter everything moved along in quiet harmony. The meeting having been called to order, Mr. E. C. Brown, as Managing Director of the Gas Industries Company, in neat phrase welcomed the Association, after which some routine business was transacted. The report of the Executive Committee, and the reports of the Secretary and Treasurer as well, showed that the Association was in every respect on a solid, substantial footing, and the roll call disclosed the presence of 75 members. President Penn having read his address—and a clever, commonsense message it was—he called upon some of the visitors to have a word to say to the Association. Clever impromptu speeches were made in response to these invitations by Mr. A. B. Slater, of Providence; Gen. John P. Harbison, of Hartford; Mr. T. Littlehales, of Syracuse; Mr. Geo. B. Neal, of Charlestown, Mass.; Mr. F. E. Barker, Chairman of the Massachusetts Board of Gas and Electric Light Commissioners, and Mr. George G. Ramsdell, of Philadelphia. At this point the Association having learned of the sad affliction that had befallen Mr. George D. Roper, who had just been informed by telegraph of the death of his father, tendered a vote of sympathy to their fellow member over his loss. Other speeches in responses to the invitations to have a word with the Association were then made by Mr. B. E. Chollar, of St. Louis; F. C. Sherman, of New Haven, and Mr. William McDonald, of Albany. The first paper read was that by Mr. T. C. Jones, of Delaware, O., whose theme was "Gas Stoves: Their Introduction, Construction and Use." A right good, valuable discussion ensued. A dip was then made into the Question Box, and query No. 7, "What is the best furnace for annealing sheet zinc and copper?" was debated at length. The paper by Mr. G. H. Christian, of Norwalk, O., on "State Regulation of Corporations," and the discussion thereon, brought the morning session to a close. The afternoon proceedings were opened by the reading of the paper by Mr. E. F. Lloyd, of Fort Wayne, Ind., who presented a sensible statement respecting "The Large Gas Engine: Its Present Development and Forecast of Its Future for Electrical Purposes." The discussion on this paper showed that much close thought is being given to a matter now more than ever fraught with interest and profit for the gas man.

The paper by Mr. J. F. Seamon, of Uniontown, Pa., on "Some Facts Relating to Gas and Electricity," was listened to with attention, and discussed with vigor. The details furnished by Mr. Irvin Butterworth, of Columbus, Ohio, respecting "A Curious Gas Explosion," having been dissected, the last set paper on the list, that by Mr. E. S. Templeton, of Ashtabula, Ohio, was read and debated, and the hour for adjournment was reached. This was a remarkably clever record, for under President Penn's guiding hand everything worked along smoothly, and the members held right to business. But despite the cleverness of an executive and the willingness of the members to assist, we think it is a "record" to dispose of 6 important subjects for debate in one day, without slighting anyone or anything.

In the evening, of course, the Exhibition was the irresistible force that held the visitors. The scene on the floor of the Garden at 9 P.M. was well worth witnessing. Animation, interest, good fellowship and numbers were the concomitants that carried the time to the enjoyment of the lunch prepared for the gas men by the "Manufacturers of Gas Apparatus and Specialties," the subscribers to which entertainment were: The American Meter Company, Althouse & Kennedy, The Brooklyn Fire Brick Works, Bartlett, Hayward & Co., Wm. M Crane & Co., Continental Iron Works, John Cabot, J. D. & T. E. Crimmins, Connelly Iron Sponge & Governor Co., M. J. Drummond, Deily & Fowler, James R. Floyd & Sons, Greenpoint Chemical Works, J. H. Gautier & Co., E. P. Gleason Mfg. Co., Hazelton Boiler Co., Humphreys & Glasgow, Maryland Meter and Mfg. Co., S. F. Hayward, Wm. McDonald, George Shepard Page's Sons, Perkins Co., Parker-Russell Mining & Mfg. Co., Standard Oil Co., United Gas Improvement Co., R. D. Wood & Co., Adam Weber, Westmoreland Coal Co., and the Welsbach Commercial Co.

The luncheon was served in the room which had been devoted to the demonstration lectures on gas cooking, and was preceded by an interesting "vitascope" exhibition. An orchestra, and later on the Old Guard Band, provided sweet strains for the lunchers, and the gentlemen of the Committee were unremitting in their attentions to their guests. The guests were welcomed by Mr. Charles H. Corbett, Chairman of the Committee, and later on, when speechmaking was in order, Captain W. H. White, as Master of Ceremonies, as he always does, aptly introduced the speakers. Prominent among the latter were: Prof. T. S. C. Lowe and Prof. Chas. F. Chandler. The festivities were at an end by midnight, and over 300 guests thoroughly enjoyed the hospitality of their hosts. The proceedings of the second day's session, which was convened at 11 o'clock of Thursday morning, were marked at the outset by the holding of an executive session, the proceedings at which, of course, will be unreported. It was a first-class experience meeting, and was in every sense a success in the matter of "speaking right out." At this session many of the queries in the Question Box were discussed. On the adjournment of the executive session the Question Box contents were finished. This closed the technical portion of the programme for the meeting, and we can, and do, say, that it was an excellent programme thoroughly well lived up to. Further, the Ohio Association has just cause for pride over it, and the fraternity at large will be pleased to share its benefits through the reports of it to come. Routine business completed the meeting, and a summary of it is appended. The officers elected were:

President—Mr. W. C. Boyle, Salem, Ohio.
Vice-President—Mr. B. P. Holmes, Youngstown, Ohio.
Secretary and Treasurer—A. P. Lathrop, Columbus, Ohio.
Members Executive Committee—E. S. Templeton and T. C. Jones.

The report of the Committee on Election of New Members, reporting favorably in respect of the addition to the rolls of 9 applicants, was indorsed, and Cleveland was named as the next meeting place. The minute to the memory of the late Mr. Joseph Russell Thomas, who was elected to honorary membership by the Association in 1884, which was submitted by a special committee, was a most beautiful tribute to the worth of the deceased and a striking testimonial of the regard in which he was held by the Association. The President-elect and the Vice-President elect, in response to the announcement of their promotion, made clever acknowledgments of the same, after which hearty votes of thanks to the retiring officers, to Mr. E. C. Brown, on behalf of the efforts for the Association's entertainment by the Gas Industries Company, and to the Associated Manufacturers for their hospitality, were adopted and the meeting was declared adjourned.

THE "GAS TALK" PROGRAMME.—On the evening of Thursday the Gas Industries Company had arranged a special programme of a literary nature for the entertainment of the visiting gas men. The concert hall of the Garden was chosen as the lecture room, and the regular proceedings were preceded by a vitascope exhibition that was greatly enjoyed by a large assembly. The first speaker to address the audience was Prof. Charles F. Chandler, whose lecture was chiefly devoted to outlining the benefits to be gained by gas consumers through the application of common sense methods in their employment of correct principles and suitable devices for obtaining the best results from the gas used by them for lighting, cooking, power, etc.

President Henry Morton, of the Stevens Institute of Technology, then delivered a well-put together address, the trend of which was somewhat similar to the remarks by Prof. Chandler. Mr. E. C. Brown then read a paper which had been specially prepared for the occasion by Prof. Vivian B. Lewes, of England. The paper was in the Professor's best vein, and that is surely praise enough, for whatever he writes is always well put. The Lewes paper concluded the "gas talk" programme.

NOTES.—The Columbus (O.) Gas Company has placed an order with Messrs. Riter & Conley, of Pittsburgh, Pa., for a triple lift holder, in steel tank, the vessel to have a capacity of 1,750,000 cubic feet. The diameter of the tank is to be 157 feet, and its depth is to be 34 feet.——The transfer of stock from the San Francisco Gas Light Company to the San Francisco Gas and Electric Company is about completed.——At the annual meeting of the Washington (D. C.) Gas Light Company the Directors chosen were: John R. McLean, James W. Orme, John C. Sullitt, George T. Dunlop and John F. Rodgers. The only change in the Board from last year is the naming of Mr. Rodgers to fill the vacancy occasioned by the death some months ago of Mr. W. B. Webb.——The proprietors of the Princeton (N. J.) Gas Light Company have reduced the selling rate to $2 per 1,000, a concession of 25 cents. ——The plant and franchises of the Thomasville (Ga.) Gas Company were sold at Receiver's sale on the 2d inst. The purchaser was Mr. Charles R. Long, of Louisville, Ky., whose bid was $6,200.

[Translated for the JOURNAL, by Mr. Herman Poole.]

Transformation into Alkaline Ferrocyanides of the Sulphocyanides Produced during the Manufacture of Illuminating Gas.

By M. ANDRE DUBOSC.[1]

That distillation of coal, which gives birth to illuminating gas as the primal product, also generates many secondary products, such as coke, retort carbon, ammoniacal liquors, tar, sulphur, various sulpho and ferrocyanides, the chemistry of which has assumed a more and more important position since the price of illuminating gas is decreasing each year.

Without stopping to consider the tar, coke, retort carbon, or sulphur, let us examine what may be the importance of the bye-products comprised under the general classification of sulpho and ferrocyanides. Sulphur, nitrogen and iron, being contained in small proportions in coal, sulpho and ferrocyanic acids are formed by the combination of these various molecules under the influence of the high temperature which exists in the retorts during distillation. In contact with the ammonia, produced with them at the same time, they unite partially to form ferrocyanide and sulphocyanide of ammonium which are found in the ammoniacal liquors of the hydraulic main and the washing; another portion of these acids is retained in the purification material in the form of ferro and sulphocyanide of calcium.

Up to the present time the spent purification material has been used solely from the point of isolation of one of those bye-products; this process, devised by Gautier-Bouchard, has permitted the manufacture of the prussiates at a relatively low cost, and its use has caused an almost complete abandonment of the old method of manufacturing these products from nitrogenous animal matters.

The spent purification material comprises, besides sawdust, iron oxide and gypsum, which are the original constituents, sulphur, Prussian blue, sulphocyanide of calcium, ammonium and iron, and ferrocyanide of ammonium. The proportions vary from 1 to 4 per cent. of sulphocyanhydric acid in the state of iron or ammonium salts, and from 3 to 9 per cent. of ferrocyanide of potassium in combination with various other ferrocyanides.

Sulphocyanides are soluble in water, and a part of the ferrocyanides requires an alkaline liquor for solution. In practice the spent material is treated with milk of lime, either cold or warm, for, according to Kunheim, this latter method of procedure is preferable, and, if worked in a closed vessel, allows of the recovery of most of the NH_3 contained in it in the state of cyanogen combinations. The mixture of lime and sulphate of soda recommended by Esop gives likewise very good results. The wash water so obtained contains, in the state of calcic or sodic combinations, the ferro and sulphocyanhydric acid contained in the spent Laming mass.

If, in place of this mixture, lime purification is the plan pursued, a simple leaching with warm water will allow the extraction of the ferro and sulphocyanhydric acids in the state of calcium combination.

According to the richness of the materials which has produced them, these cyanide liquors are of variable strength, and may be enriched either by methodic lixiviation or by concentration.

We have hardly given to one matter its proper importance, for, to one of the elements, ferrocyanide of calcium, the source from which is produced the prussiate of potash and soda being used, while the sulphocyanide has been almost completely neglected.

The separation of ferrocyanide from the leach liquors, is produced by two quite simple methods. First, by crystallization after concentrating the leach liquors to between 38° and 40° B, in which case sulphocyanide of calcium remains almost entirely in the mother liquor; second, by precipitation from treating the leach liquors with a ferric salt, which throws down all the ferrocyanide contained as Prussian blue. With a sulphate, the lime is precipitated as sulphate with the Prussian blue; with a chloride, it remains as chloride of calcium in the mother liquor. The sulphocyanide is found in such a case transformed into sulphocyanide of iron, which remains in the filtration liquor.

These mother liquors, or filtration liquors, are generally considered as being of so little value that they are thrown away; still, at the same time, they contain estimated in "prussiate of potash," more than 6 pounds to the cubic foot.

Nevertheless, for several years certain products with a sulphocyanhydric acid base have been put on the market, especially by the works of Gunsburg, Tscherniac and Norton.

Sulphocyanide of aluminum, for example, gives a dye and print with alizarine red superior to those obtained with acetate of aluminum; sulphocyanide of copper, the "white paste" of the English dyers, may be successfully used as a substitute for vanadium in the production of aniline blacks. It also replaces phosphorus in the manufacture of matches, and gives substitute for mercury salts, excellent submarine paste; and finally, sulphocyanide of potassium replaces advantageously cyanide of potassium in electro plating and photographing, while being a less dangerous salt.

Unfortunately, the synthetic method originated by Tscherniac, to obtain these sulphocyanides produces these products at a price too high to allow of its use in the arts, and chemists have passed by an abundant source of these products without noticing it. On the other hand, the large consumption of cyanide of potassium in recent times for the extraction of gold in the Transvaal, has attracted attention to these bodies as being susceptible of furnishing cyanhydric acid and its compounds at a low price. The synthesis of cyanide of potassium, made last year at Nantes, by M. de Lambilly, marks the first step on this road.

It is possible, utilizing the residual sulphocyanides from gas manufacture which the arts reject to-day, to extract from them the sulphocyanides in the state of ferrocyanides or cyanides.

These sulphocyanides are formed: First, in the leach waters of the purification material, after we have extracted or removed the ferrocyanides by concentration or by precipitation; second, in the ammoniacal liquors. Various methods have been devised to obtain it as sulphocyanide of soda or potash.

Mother Liquors from Ferrocyanide of Calcium.—These water liquors are treated with a salt of soda or potash so as to precipitate the lime. After filtration they are evaporated till solid. This solid residuum is pulverized before treating for ferrocyanide of sodium or potassium.

Filtration Waters from Prussian Blue.—The sulphocyanide is found in combination of a ferric salt. The iron is precipitated by soda or potash and the clear liquid concentrated till it sets. This is then pulverized the same as the foregoing case.

Ammoniacal Liquors.—The sulphocyanide of ammonia which is formed is decomposed by a protosalt of copper as insoluble sulphocyanide of copper $(CyS)_2Cu_2$. This sulphocyanide is then treated with soda or potash, the copper precipitated and the alkaline sulphocyanide liquor obtained concentrated as before.

The transformation of alkaline sulphocyanides into ferrocyanide of the same base was indicated, in 1881, by Tscherniac, and results from the following reaction: When we heat sulphocyanide of sodium or potassium with finely divided iron to a temperature of 450° C., the iron separates the sulphur from the sulphocyanide to form sulphide of iron, producing cyanide of sodium or potassium according to the equation—

$$CyS\left\{\begin{matrix}K\\Na\end{matrix}\right. + Fe = FeS + CyS\left\{\begin{matrix}K\\Na.\end{matrix}\right.$$

If we treat the mass thus obtained with water, we will have the formation of prussiate of soda or potash, and sulphide of sodium or potassium, according to the equation—

$$^4(KCy) + FeS = K^4Fe\,(Cy^4) + K^2S.$$

Tscherniac has carefully studied this reaction which he hopes to have adopted in the arts.

The alkaline sulphocyanide is mixed with pulverized iron turnings and heated to 450° C. in a furnace with double walls, the space between the walls being filled with sulphur heated to boiling, so as to produce a constant temperature of 450° C., necessary for the proper working of the reaction. The melted mass is next treated with water and the ferrocyanide is separated by crystallization.

1. Communicated by the author to the Industrial Society of Rouen.

Gas Control from Meter to Burner.

[A lecture delivered by MR. D. MACFIE, before the District Council for Edinburgh, Scotland, of the National Registration of Plumbers.]

Mr. Macfie said that in this age of sanitary science, when plumbing is looked upon as "a handmaid to health," there was some danger of gasfitting—a modern and always subordinate branch of their trade—receiving less attention than its importance demanded. At the outset, they noted an essential difference between the official control of the public supplies of gas and water. Water companies and trusts exercised control not merely up to the service cock, but within doors, from garret to basement; and they reserved their right to inspect every fitting through which the water took its course. Gas companies or commissioners did not, on the other hand, state any particular concern with the indoor condition of pipes or fittings, beyond fixing the meter, from

which point the consumer might waste or utilize the gas as he pleased. The difference was easily accounted for. Water was supplied under assessment, while gas was duly measured, and must be paid for accordingly. Waste of water fell on the water trust; while waste of gas was profitable to the seller, who was under no obligation to educate the buyer of gas. In the use of gas, therefore, tradesmen and their customers had a field for the exercise of economy, such as they had not in connection with water supply. The public needed enlightenment in the proper use of gas, and it was for gasfitters to study the problem and to educate their clients on the subject. If they did not do so the time might come (and in some towns it had already come) when the fitting up of gas pipes, the supply of gas stoves, and the gratis distribution of gas burners, would be undertaken by the sellers of gas.

The quality of gas in Scotland differed from that used in England and Ireland. There were Scotch Companies who still supplied gas of from 28 to 30 candle power. The larger towns had lowered the quality, and to-day Scotch gas varied from 20 to 30 candle power. In Edinburgh it would not be uncharitable to assume that it averaged 25 candles. Except in Scotland, the illuminating power of gas ranged from 14 to 20 candles; but it might be said that, as a rule, Edinburgh consumers did not develop the lighting power of the gas supplied to them so well as did their friends in the South. The reason was not far to seek. The English consumer had never known any higher quality; his gas was cheaper per 1,000 cubic feet, and he had all along used burners to fairly well develop the lighting value of the gas which he bought. On the other hand, the Edinburgh gas consumer was brought up with gas of from 28 to 30 candle power, and at one time smaller burners served his purpose. He had not yet been brought face to face with the fact that the conditions were changed, and that a burner which might have been fairly satisfactory with a 30-candle power gas could not profitably be used with a gas of 5-candle power less. It was not necessary either to uphold or condemn the policy pursued in Edinburgh, of lowering the quality, so soon as the Corporation took in hand the business of gas supply. But when this step was resolved upon it was the duty of the Gas Commissioners to intimate that (for reasons of policy or expediency) it had been found wise or necessary to lower the illuminating quality of the gas, and that to maintain equal light consumers should replace every burner in use, by a burner at least one size larger. An intimation to this effect would have saved much grumbling in the public interest.

He need not discuss the merits of high versus low illuminating power gas, though it was a subject on which much could be said; but the weight of opinion, or perhaps the force of circumstances, was tending to lower rather than to increase the lighting quality, and the causes which were bringing this about were: The enhanced price of cannel coal; the increasing use of gas for heating and cooking; and the introduction of the incandescent gas burner. For this latter purpose 15-candle power gas was to be preferred to that of 25-candle power. Assuming that 25-candle power gas was what they had to deal with in Edinburgh, the question was how to develop this power in actual use. It could only be done by understanding the conditions of gas supply as it affected the various forms of burners, in developing or enhancing the lighting power up to or beyond the nominal value.

The meter was the proper starting point for the subject in hand; but, in advance, some reference might be made to the outdoor conditions which regulated volume and pressure—the two main factors in the problem under review. They need hardly be reminded that, as to pressure, water and gas differed essentially. It was an axiom that water could not rise above its own level; and the greater the head of water the greater the pressure. Gas, being lighter than the atmosphere, was not subject to this law; and for this reason the pressure of gas increased as it rose from its source, by a fixed gradation of one-tenth of an inch for each 10 feet in its ascent. But, as practical men, they would realize that even such fixed laws as that "water would rise to its own level," and that "gas pressure increased according to altitude," were subject to important modifications when mains were too small for the draught made upon them, and where service pipes were fitted without reference to the duty they had to perform. Variation in pressure was not wholly a question of levels, for it was necessary to vary the initial pressure at the gas works according to the draught which might be made at different hours and seasons, and to compensate for the inequalities in the size of street mains. It would thus be seen that there could not be uniformity of pressure throughout, even if the gas were to leave the works at a uniform pressure. This would be possible only in a perfectly flat country, where the mains were so amply sufficient, and the demand so uniformly steady, as to permit of unvarying control. But these ideal conditions nowhere existed. This initial difficulty was greater in such a district as theirs, where there was so large a variety of levels; although attempts were made to equalize pressure by the use of district governors, which answered to the pressure changes at the gas works. The net result of these conflicting elements was that there could not be uniformity of pressure in any two districts of the city. But it was certain that the problem was not how to *increase* the pressure, as was often suppposed, but rather how to regulate or control it so that, at the point of issue, the gas would be delivered in sufficient volume, and at the pressure best suited, for the purpose in view.

To assist in this, they required a gas pressure gauge, which was an essential gasfitters' tool. No kit, or at least no shop, should be without one. With flat flame or Argand burners, the best results were obtained at a pressure of 5-tenths at the point of ignition, which low pressure permitted of proper combustion, but the flame would appear sluggish, and, when much disturbed, would give off smoke. Any increase of pressure resulted in a whiter, but less luminous flame—an evidence that the carbon particles were being forced through at too great velocity. This prevented efficient combustion, while giving off greater heat, and rendering the atmosphere stuffy and unhealthy in proportion to the increase of pressure. If pressure were unvarying, even if high, it would be possible to recommend the so-called "regulator" burners, which could be made to consume an exact quantity of gas per hour at any given pressure. But such burners, if sent out and used promiscuously, were not regulators in any efficient sense, but merely checks to flaring and hissing. They did not insure that only a given quantity of gas would pass the burner, irrespective of variations in pressure. All of the so-called "regulator" burners required governing quite as much as simple burner tips, though the controlling power was not called for so early in the range of pressure. The regulating burner was, in fact, an ordinary burner stuffed with so many plies of muslin, which merely acted on the flow of gas, and did not insure that only a given quantity would pass the burner at varying pressures. Such a burner might, for example, consume 3 cubic feet of gas at 5-10ths pressure, and at 3-10ths it might consume as much as 6 cubic feet per hour, and with nothing like a proportional increase of light per foot of gas consumed. It had to be borne in mind that, even under the most favorable conditions, the full lighting value per cubic foot could not be developed in a flame which consumed less than 5 cubic feet per hour.

It might not be out of place to suggest that with Edinburgh gas of 25-candle power, the use of all burners smaller than No. 4 should be confined to bathrooms, passages and cellars, where light was only wanted occasionally, and not much of it. And yet the Edinburgh lighting authorities—alongside of a worthy, if extravagant, zeal for the luxury of street lighting by high power electric lamps—were content to continue the lighting of their less favored streets with burners set to consume about 2 cubic feet per hour, in lamp posts over 9 feet high, at a distance of from 20 to 30 yards apart. Before the Corporation took over the gas undertaking, there was some excuse for restricting the output, seeing that the gas companies had to make a profit out of the gas supplied for street lighting; but even then the poorly lit streets of the city were a by-word and a reproach. When the Corporation became the proprietors of the gas undertaking, it might have been supposed that larger burners would be adopted, and that at least a 3 cubic feet flame would be substituted. But when the candle power of the gas was lowered, larger burners were necessary to develop the former equivalent in lighting value. The existence of streets brilliantly lit by electricity, alongside of streets in the same city lit with gas burners giving less than 10-candle power illumination (the sources of supply in both cases belonging to the citizens), was indefensible; and its continuation could only be the result of indifference on the part of the public or its servants. What the public had a right to expect was that every street lamp in the city should be supplied with a governor burner, developing something like 25-candle power illumination; and this could be attained by an additional gas consumption of 3 cubic feet for each lamp per hour, which, for 1,000 lamps, would amount to 3,000 cubic feet, costing the Corporation not more than $1.87 per hour additional for each 1,000 lamps. The present burners could be altered to meet the case for a few cents each; and this would serve until a Convener of Lighting was brought to see that the old lamp globes—made for use with the rat-tail jet, and to be lit with the old lamp and ladder—were not designed for lighting with rods, and were, in fact, robbed of any virtue they had, by the cutting of a hole for lighting, which increased risk of breakage, and served as an injector for every wind that blew, and prevented the steady burning of even one poor 2-feet flame. He knew of nothing more pathetic as an exhibition of gas lighting than to note the fantastic behavior of an Edinburgh street lamp burner during a high wind, as

the draught played through the torch hole, and swirled within the globe. The advantage of low pressure flames might be seen at night in the four burners displayed before them. Each of these burners had been carefully adjusted to pass the same volume of gas—viz., 5 cubic feet per hour; the difference being one of pressure only. At the point of issue, the pressure was, in the first instance, 3-10ths; in the second, 8-10ths; in the third, 13-10ths; and in the fourth, 17-10ths. It required no photometer to indicate that the gain in lighting power was increased as the pressure was lowered, and the luminous flame in the burner consuming 5 cubic feet at 3-10ths illustrated the highest possible duty attainable in a flat flame burner, though the pressure was too low for actual use. On the other hand, the burner consuming 5 cubic feet at 17-10ths might be held to fairly represent the average duty of the burners generally in use throughout the city.

It was thus manifest that rich gas, improperly consumed, might be of less value than poorer gas properly utilized. Atmospheric or Bunsen flames gave best results at a pressure of 10 10ths or 1 inch pressure. This included all atmospheric gas stoves, gas engines, and also incandescent gas burners. Any less pressure was liable to cause lighting back; and in the case of the Welsbach burner, low pressure tended to blacken the mantles. These were conditions which should rule in front of the meter; and proper results might be secured or not, according to the details of piping, the selection of burners, and the regulation of volume and pressure.

They might now follow the gas supply within doors, from meter to burner. With the gas service, they had practically no concern; and since meter rents had been wisely abolished in Edinburgh, the measuring apparatus was outside their control. But it might be their duty to advise as to meter capacity, and in some towns gas meters were still included in the gasfitter's contract. It was of the first importance that the meter should be of sufficient capacity for the free delivery of the maximum quantity of gas likely to be required. It was not unusual in Scotland to find meters doing four or five times their nominal duty; and it was no wonder if, in such cases, consumers complained of poor light. But the pity was that they were often content to grumble, and declined to have a larger meter put in, lest the bigger one should increase their gas bills. Of course, if more gas were used, it must be paid for; but one might as well object to a big pair of scales as more likely to be unjust than a lesser pair. It had been usual in Scotland, with their richer gas and smaller burners, to consider a 5-light meter sufficient for 10 burners; and a 10 light meter sufficient for 20 burners; and so on. This was the safe margin of duty under average conditions of pressure. Any meter, therefore, which had a much greater draught on it than 2 burners for each "light" must be overdriven, and could not be properly governed. If allowance for gas stoves had to be made, each heating stove should count as 4 burners, and gas cookers should be taken as 6 or 8 burners, according to size. The diameter of the meter connections fixed the size of the rising main, which should be of the same diameter, while the meter cock should have the largest possible clear way.

Starting from the meter with a full sized pipe, there was room for difference as to its material. In Scotland there was a general preference for block-tin pipe, which was indeed first made in Edinburgh and introduced by Mr. James Milne, who in the earlier days of gasfitting used copper pipes, and only discarded them when it was found that the passage of gas through the copper set up an injurious chemical action. As a medium for passing gas, nothing could surpass that pure metal (with its clear bore and smooth surface) when well and truly laid. But it had one drawback, in its attraction for joiners' nails, and the liability of picture nails to find it. Even with these defects, it would hardly have gone out of favor but for the introduction of what was at first called "patent composition pipe." This, with its superficial coating of tin, had largely supplanted block-tin pipe; and by its leaden softness, and its liability to festoon between the hold-fasts, and to gather moisture, it had done more to discourage the use of metal pipes than anything else. It was not to be wondered at if architects and engineers had sought relief in wrought iron piping, which had the advantage in rigidity and resistance. But when all was said that could be said in its favor, one might urge a return to block tin piping for indoor use, at all events from 1 inch downwards. The making of wood casing for electric wire and cable was already an industry; and there was nothing to prevent its being used for a tin tube, from 1 inch downwards, and used with advantage. He did not go into details, but threw out the suggestion; and, by way of illustration, he has prepared a few fittings showing the application of wood casing for gasfittings of tin tube, which would apply equally to the leading of iron tube in front of plastered walls.

Suppose a mansion house of three floors was to be fitted with (say) 40 burners, and, in addition, two gas fires and a cooking stove. Of the 40 burners, assume that three-fourths would be in use at one time. Allow for 30 burners consuming, on an average, 4 cubic feet of gas per hour, of 25-candle power, equal to 120 cubic feet. Take each gas fire at 18 cubic feet per hour, and the cooking stove at 32 cubic feet. There would then be a delivery in all, of 190 cubic feet per hour. A gas meter would pass 6 cubic feet per light at 5-10ths pressure, and so a 30 light meter would give, even at this low pressure, sufficient volume, which would be increased if the gas were delivered at 10-10ths pressure. A 30-light meter was supplied with connections of 1¼-inch bore, and the rising main should correspond in diameter, which, however, might be reduced on the second or the way to the third floor. Long runs of small sized pipes should be avoided, and ¼ inch pipes should never be used except to supply single burners at no greater distance than 6 feet from the branch supply. For the two gas fires and the cooking stove a separate branch should be led from the rising main near the meter, of ¾-inch bore. If this were done, it might be reduced to ½-inch on its way to the cooking stove, while each gas fire should be fed with ½-inch pipes, taken off the ¾-inch branch.

Piping of sufficient capacity being in position, the question of regulation arose, and they might assume that the pressure varied from 5 10ths in the morning to 30-10ths in the evening. Even the lowest pressure named was wasteful either for cooking, lighting, or heating. The course open to them at this point was to fit a pressure governor on the stove supply. But they had still to deal with the lighting section of the supposed installation. If they fixed a second mercurial governor on the rising main, and adjusted it to 5-10ths they might proceed to fix non-regulator enamel tip brass jets throughout—taking care to select the size of jet according to the illumination wanted. But, of course, they should have 6-10ths on the first floor, and 7-10ths on the second floor, which slight increase of pressure was of small moment. But a new factor in lighting had in these days to be kept in view. The incandescent burner was sent out adjusted to consume its proper volume at 10-10ths pressure. This suggested that one meter governor would serve both purposes, and hence they had the alternative of using one 1½ inch governor to control both the lighting and heating. But when adjusted at 10-10ths pressure for stoves and incandescent burners, their non-regulating burners would be wasting gas at the increased pressure. This, again, could be met by so-called "regulator" burners, made specially to consume their regulated volume at 10-10ths pressure, but not the stock article which was, roughly speaking, stuffed to check a 30-10ths pressure.

Leaving these ideal conditions, let them see what was found in every day use and what was the required treatment. In the early days of gas supply in Edinburgh, the quality of gas was no doubt quite 30-candle power; and the burners then used would not, on an average, consume more than 2 to 3 cubic feet per hour. Thus the pipes which might be sufficient in the old times were not adapted to the changed conditions. Supply pipes were often led from the meter forward with no regard to the duty required at the various lighting points. As a general rule, there was an excess of pressure at the meter outlet, along with a deficiency throughout in the pipe capacity, which practically prevented proper regulation of pressure, or equal distribution of volume.

Compared with the specification already given in a supposed case, let them compare the actual state of things in a typical Edinburgh West-End mansion. The house was of six floors, and was fitted with 130 burners, with the addition of a gas heating stove and a small cooker. Reducing their former proportion, let them assume that the pipe supply should be sufficient for only one-half of the lights, provision should be made for 65 burners at 4 cubic feet each—equal to 260 feet; for a gas fire at 16 cubic feet, and for a cooker at 30 feet—a total delivery of 306 cubic feet per hour. For this quantity a 40-light meter at least would be required. Instead of this a 20-light meter had been fixed, with 1¼-inch rising main, and (as if there were an excess of gas) a mercurial meter governor had been fitted and adjusted at 12-10ths. The limit of delivery by a meter at this pressure was about 200 cubic feet; so that, at no time could there be, throughout the house, more gas than sufficient to supply 50 four feet burners—about one third of the number fitted. Yet, again, the burners in use were the ordinary "regulator" burners, checked by stuffing to reduce 5 10ths to 30-10ths pressure—still further complicating the conditions. The only really efficient gas burning appliance was a heating stove on the sixth floor, which, being at the highest draw off point, resulted in a pressure of 18-10ths because of its height above the governor. It was hardly possible to conceive a less satisfactory condition of things, yet it was not uncommon.

Now the logic in such a case as that was to condemn the whole thing, "stock, lock and barrel," but this would involve as much dis

turbance as, and hardly less experience than, would pay for an installation of the electric light. Short of absolute condemnation, the practical point was what could be done to help matters in such like circumstances. First of all, it should be easy, without incurring expense, to get the gas authorities to put in an increased service, and to fix in position a 40-light meter. It would be possible, further, to carry a 1¼-inch rising main from the meter to some convenient height, and to reduce it on the second or third floors—making connections with the existing pipe and with the various main branches *en route*. No doubt these branches would still be unequal to supply the burners with sufficient volume at low pressure, and hence a meter governor would be useless. The existing meter governor could be used for controlling the pressure to the gas cooker in the kitchen at 10-10ths, and a smaller mercurial governor could be fitted on the sixth floor level, to control the pressure for the gas stove. Governor burners could also be used. There were several forms of such burners; but there were none at once so reasonable in price and so scientific in construction as the "Needle" governor burner made by their neighbor, Mr. Bruce Peebles. These burners met the case in point; and if, to complete their imaginary taste of improving the conditions described, they fitted these burners throughout their West-End mansion—carefully assorting the sizes of burners to the light required—the work would be well done, and would be worth doing, in the interests of the consumer.

After describing the development of the gas burner, Mr. Macfie, speaking of the regenerative form of burner, said that there were those, of whom he was one, who thought highly of that system, and who were content to take all the trouble and risk which the use of these lamps involved, in view of the quality and color of the light, its diffusiveness and penetration, its steadiness and its lighting duty. But reference had still to be made to the most marvellous development which had yet taken place in the history of gas lighting. The story of the Welsbach incandescent gas burner read like a romance. It was a triumph of chemical research and mechanical skill, and the perfection of its manufacture had been arrived at by the overcoming of technical difficulties. It was not sufficientiy realized that a considerable waste of gas might take place in the use of the incandescent burner, as with any other system of gas lighting; and therein was a field for efficient control. As they had seen, in ordinary circumstances a uniform pressure of 10-10ths was unknown, and the need for governing became apparent. Where the pressure at the burner did not exceed 6-10ths to 8-10ths an incandescent burner could not give satisfactory results, as the flame would have little life—barely filling the mantle, and making it only partly incandescent, while blackening it at the top. On the other hand, where the pressure exceeded 10-10ths during the day, and increased after dark to 20-10ths or 30-10ths, the Bunsen flame would be found to shoot over the mantle, and would probably cause a reddish ring outside the mantle. Then, instead of 2½ cubic feet, it might consume 3½ cubic feet, with no perceptible increase of light. Such a flame, being non-luminous, did not smoke, and was not visible when shades were used; but it was wasteful, and unduly vitiated the atmosphere. This feature would, therefore, be carefully looked for; and where in evidence, a volumetric governor, set to consume 2½ cubic feet, should be fitted underneath each burner.

The one and only drawback to the universal adoption of the Welsbach burner was the frail and perishable nature of the mantle. Every attempt to preserve the mantles from breakage was to be welcomed; and there had been many such. It was with some misgivings that he brought before them a modest effort of his own in this direction. The presumption was that many mantles were broken in putting on or taking off the chimney—due to its tight fitting. A Bunsen burner did not, *per se*, require a chimney; and the Welsbach mantle did not require a chimney for its incandescence. A chimney, however, was an advantage in directing the draught and as a protector; but it need not be gripped at its root, nor descend much below the point of issue of the flame. The device before them was a suspension chimney, with the ends in view of giving ease in placing in position and withdrawing for cleaning, and decrease of draught by a larger diameter and by stopping short just below the mantle. The article was not, and might never be, on the market; but it was there for illustration.

The lighting quality of the incandescent mantle was more intense than diffusive; and in actual use it was realized that its best light was given on the horizontal plane, while its downward light depended largely on the shade used. Professor Lewes emphasized the merits of the "Holophane" globe for the enhancement of its lighting value by diffusion below the horizontal plane. These Holophane globes showed a combination of horizontal and vertical prismatic lines, which combination diffused the light evenly, and reduced the glaring intensity of the concentrated light point. The series of tests made by Professor Lewes were almost startling in their results, as ascertained on the radial photometer; and even if, in actual use, they should fall short, the gain must be considerable, and the adoption of that type of globe was assured. At an angle of 45°, the clear Holophane showed a gain of light equal to 12 per cent. Ground glass globes showed a loss equally great, and white opal a loss of 2 per cent. It had to be added that no claim was made on behalf of the Holophane globe that it increased the source of light, but only that it utilized the light emittted, and distributed and diffused it in the right direction, and this was a clear and practical gain.

The Welsbach burner had come to stay, and they should be ready not only to keep in touch with progressive improvements in gas lighting, but to welcome every new development which scientific attainment could accomplish in the direction of giving them "Light, more light." These considerations led to the following conclusions: That the usual conditions of supply rendered uniform pressure at the consumers' meter impossible, and that the variations in pressure inevitably resulted in unequal duty in the ordinary use of gas for lighting and heating, and tended to wasteful consumption of gas and undue vitiation of the atmosphere; that, as a rule, the pressure at the meter outlet was excessive, and ought to be governed or controlled in some efficient way; that if meters were of sufficient capacity, and the indoor piping were properly distributed, and at the same time large enough for the duty required, meter governors should be universally adopted, in the interests of true economy and healthy atmospheric conditions; that for a system of flat flame burner lighting, meter governors should be adjusted at 4-tenths to 5-tenths pressure, and in such cases non-regulator burners should be used, while for lofty buildings governors should be fitted on each alternate floor; that where gas stoves or incandescent burners were in use, meter governors should be adjusted at 10-tenths to 12-tenths pressure, and in that case ordinary enamel-tip regulator burners should be packed to do duty at 10 tenths pressure; that where pressure and volume in the same installation varied owing to irregular and insufficient piping indoors, meter governors should be used only on gas stove supply pipes, led direct from a point close to the meter outlet, and separately controlled at a pressure of about 10 tenths, and under these conditions only volumetric flat flame governor burners should be used, and similar governors should be fitted to each incandescent burner—tests being made to see that the pressure at the point of issue for incandescent burners should not be less than 10-tenths; that flat flame burners should be selected to suit the quality of gas in use and the light required, and that the burner tips should be renewed periodically; that the ordinary single regulator burners were wasteful at all pressures above 10-tenths, and were ineffective where pressure was much lower; that adjustable or adaptable burner tops only partially met the inequalities referred to, and were in no sense automatic in their action, but might be made serviceable in the interests of improved lighting and economy, by an intelligent and careful adjustment of tops and bottoms to suit the average conditions of pressure in each case; that the lighting duty of coal gas might be doubled or trebled beyond its nominal candle power value by the use of regenerative gas lamps or incandescent burners, and that, in addition to the resulting economy, the atmospheric conditions were (under both systems) greatly improved, owing to the more perfect combustion of a smaller volume of gas for the duty performed.

Fuel Energy into Electrical Energy.

Prof. Elihu Thomson, in discussing this problem in the columns of the *Electrical World*, says:

Notwithstanding the fact that in these days of long distance transmissions at high voltages the energy of large water powers will become more available, and also in spite of the fact that the fuel cost constitutes, in many cases, not more than 12 to 15 per cent. of the total cost attending electric distribution from stations, the problem of how to obtain an increased efficiency or a greater percentage of the potential work of a fuel as electric energy loses none of its interest. In localities where coal is cheap the actual fuel cost in the working of a plant may be such a small percentage of the total cost in interest, wear and tear, administration, supplies, renewals, etc., as not to be worth considering, since if even 100 per cent. conversion could be attained from fuel to current the saving would be almost negligible.

It is certain also that if in obtaining any increase of yield the outlay for additional plant, or for more costly plant, or for maintenance and attendance, is such as to give rise to an increased charge of but a moderate percentage over the present costs, there would be a neutralization

of benefits. Despite, then, the interest which the working out of any problem naturally has for the scientist and engineer, it remains a fact that any new plan or proposal for increasing the percentage of fuel energy rendered available must, to be commercial, accomplish its results within such limits of cost and outlay as will depend on the cost of fuel in the particular locality where the plant is to operate. By the use of triple compound condensing engines at full load 1-horse power hour may be developed at an expenditure of fuel of less than 1½ pounds of coal, a figure which is so low that in any locality where coal can be had for less than $5 per ton, places the actual coal cost for full load conditions on a favorable basis as compared with other outlays in the working of an electric plant. Indeed, the question of uneven loads and peaks in the load becomes then one of far greater commercial importance than saving of fuel alone, when the plant is working at its best, for the great waste of fuel comes in putting boilers into and out of service, while a large engine but lightly loaded is itself a wasteful piece of machinery.

Any plan of fuel saving which while providing for a given output is not flexible, or which does not lend itself easily to a system of storage, might have all its value neutralized in consequence. Much has been said from time to time concerning the advantages of gas or oil engines as prime movers, and it is certain that their efficiency of conversion may easily rise to 20 per cent. of the energy value of the gas or oil supplied.

Even in quite moderate sized engines, such as those of 30-horse power and under, one brake horse power hour has been produced for less than ¾ pound of anthracite coal made into gas by one or other of the producer methods, while in oil engines of the gas engine type the oil consumption is, even for quite small engines, about 1 pound per brake horse power hour. There is reason to believe that with the work which is being done in improving the engines and producing gas under most economical congitions, with fair sized engines, power may be generated on the basis of about ½ pound of coal or oil per brake horse power, or possibly somewhat better in the case of the oil owing to its relatively high calorific value. There can be no question about the advantages which such fuel engines have in not requiring any consumption of fuel until they are started. Similarly when stopped fuel consumption stops. For a given horse power outfit, however, the gas engines are probably more expensive as to first cost, while they require attention from time to time, as in cleaning, etc., which is not the case ordinarily with steam engines. The attention to boilers required in a steam plant might be offset in part at least by the care of a gas producing and storing plant. Strong objections, both to gas and steam engine plants of large size in cities, arise from the almost unavoidable tremor or vibration communicated to surrounding buildings. This fact has of itself led to the adoption of the Parsons steam turbine in a station in London, and may have a like effect in other places.

Whether a gas or steam engine be employed as a source of mechanical power, the conversion of the potential energy of the combustible into electric energy is not direct, but is made through the heat of combustion conferring kinetic energy on a mass of gas, which energy is partly converted into mass movement or mechanical energy, the piston being driven thereby. Similarly the many attempts to employ the thermo-electric principle rely upon an indirect conversion, but in this case there are no moving parts and the mechanical energy stage is missing. The heating of junctions of dissimilar metals in a thermo-electric series and the production of currents of electricity thereby seems at first the ideal of simplicity and practicability, but, unfortunately, despite many most noteworthy efforts to improve the thermo-electric pile, its efficiency remains very low.

It is doubtful whether a better economy than 1 per cent. of the energy of the fuel, delivered to the outside circuit of the pile, can be attained even with the latest and best constructions. The actual construction and working of the piles themselves, as well as their permanency, have undergone great improvement in recent years, but there remains the fact that of the total heat conducted from the hot to the cold junctions but a very small percentage is converted, or convertible perhaps, into electric energy. The pyro-electric generator of Edison would naturally be open to the same serious objection of insignificant yield. The remaining type of apparatus for effecting the conversion in question is that in which the fuel or carbon is dissolved as is the zinc in a battery cell, while air or some other oxidizing agent acts as a depolarizer.

Many years ago Jablochkoff devised a hot battery in which nitrate of potassium or niter was fused in an iron pot which was made one pole or terminal, and a carbon stick dipped into the fused niter was the other pole. Violent reaction occurred, due to the oxygen of the niter attacking in its hot state the carbon piece, while a fitful current of small energy value relatively to the activity of chemical reaction going on was noticed to flow in a circuit from the pot to the carbon.

Recently the battery of Dr. Jacques has commanded considerable attention. It would seem that in this battery there is in fact an actual quiet consumption of carbon without real combustion. The bath of melted sodium hydrate contained in an iron cylinder has bubbles of air passed up through it, from which oxygen is taken up. The carbon rod immersed in the soda bath is gradually oxidized and a current obtained which leaves the carbon in the bath to go to the iron containing vessel and through an outside circuit from the iron to the carbon. It is claimed that as high as 85 per cent. of the energy represented by the solid carbon is thus converted into electrical energy available for use. There are, of course, difficulties, and perhaps the chief one is the carbonating of the sodium hydrate. Unless a bath can be found which does not form carbonate, and which therefore permits the free escape of carbonic acid gas, this difficulty might indeed be fatal. The handling of fused alkalies is not as easy as might be desired and the renewal of carbons in battery cells is, of course, an objection, while the contacts to be provided for large currents passing from cell to cell through hundreds of cells appear indeed formidable. The Jacques battery also will require specially pure fuel molded carbons, so as to be of proper form and a good conductor of electricity.

In view of all this the central station manager need not, for the present at least, fear having to throw aside his boilers and engines. There does not at present loom upon the electrical horizon any such formidable competitor of the ordinary modes of generating electricity from fuel as need give him uneasiness about the value of his present plant, or give rise to any roseate visions of increased earnings due to the substitution of some new mode of generation. The smoothing out of the hills and hollows in the load diagram is apparently of more real importance in his case than systems which would double or triple the present coal efficiency, by which is meant the percentage of energy value of the fuel converted into electric current energy.

Distribution and Diffusion of Light.

[From a paper read by Mr. E. L. Elliott, before the New York Electrical Society.]

We may, for convenience, divide the subject of artificial lighting into five different sections—viz., 1, intensity or brilliancy; 2, distribution; 3, diffusion; 4, quality; 5, efficiency.

The average brilliancy of illumination which will be most desirable will of course vary somewhat with the use to which it is to be put. A "dim religious light," that would be very satisfactory for a church, would be wholly inadequate for a library, and equally unsuitable for a ball room. For general purposes it is safe to say that the intensity must nowhere be less than 1 candle-foot, and twice this brilliancy is undoubtedly better. With our present means of producing intense light, it is quite possible to exceed the limits of effective illumination, and produce a glaring intensity, which is a serious error, both from the æsthetic and physiological standpoints.

The distribution of light involves two quite distinct problems—viz.: First, the distribution of the several units into which the general source is to be divided, and, second, the distribution of the rays from the individual units. The first of these problems contains as a determining factor the illuminating, or "candle power," of the light units adopted. The determining factor in the second problem is the nature of the light source itself. The result desired is in nearly all cases the same, to secure a uniform brilliancy in a certain plane or within a given space. A room uniformly lighted, even though comparatively dim, gives an effect of much better illumination than where there is great brilliancy at some points and comparative darkness at another; the darker parts, even though actually light enough, appear dark by contrast, while the lighter parts are dazzling. For this reason naked lights of any kind are to be avoided, since they must appear as dazzling points, in contrast with the general illumination.

Aside from difference in intensity, light produces many different effects upon the optic nerves and their centers in the brain. These different impressions we ascribe to difference in the *quality* of the light. Thus "hard light," "cold light," "mellow light," "ambient light," etc., designate various qualities. Quality in light is exactly analogous to *timbre*, or quality in sound, which is likewise independent of intensity. The most obvious differences in quality are plainly those called color. But color is by no means the only element of quality. The

proportion of invisible rays, and the state of diffusion, are highly important factors; but on account of not being directly visible, they have been generally overlooked and are but imperfectly understood. It may be safely said that all rays on either side of the most plainly visible part of the spectrum are injurious to the eyes. The light of the electric arc has a very large excess of violet and ultra-violet rays, which injures the quality very greatly. Gas flames, on the other hand, have an excess of infra-red, or heat rays, which likewise injure the quality. I have heard the same charge made against the Welsbach light, but have not yet been able to verify it. The absorption of these extra-spectral and injurious rays by suitable transparent screens is undoubtedly feasible, but seems never to have been even suggested.

The importance of diffusion has also been greatly neglected. We must keep in mind the distinction between diffusion and distribution.

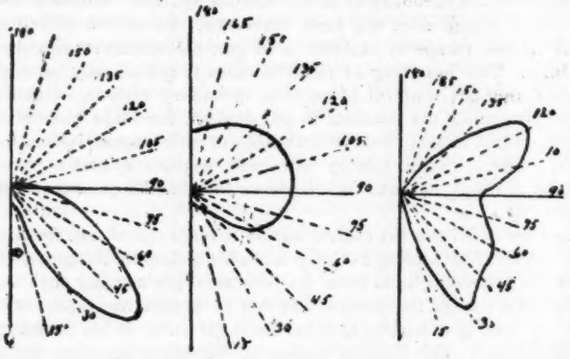

Fig. 1.—Curves of Distribution. I. Direct Current Arc. II. Flame. III. Alternating Arc.

Distribution refers to the intrinsic brilliancy of illumination at every point in the given space; diffusion refers to the number of rays that cross each point. The amount of diffusion is shown by the character of the shadow. Daylight on a cloudy day may be considered perfectly diffused; it produces no shadow whatever.

The light from the electric arc is least diffused, since it emanates from a very small surface; the shadows cast by it have almost perfectly sharp outlines. It is largely due to its high state of diffusion that daylight, though vastly more intense than any artificial illumination, is the easiest of all lights on the eyes. The eyes should be subjected as little as possible to the direct rays from any light source. It is a common and serious mistake in case of weak eyes, or overstrained eyes, to reduce the intensity of the light instead of increasing the diffusion. The eye is made to receive light and like any other organ is strengthened by use. To attempt to strengthen weak eyes by reducing the light is like attempting to strengthen your arm by putting it in a sling. Farmers who are continually out in the brilliant sunlight are almost entirely free from weak eyes. An abundance of light of the right quality is what the eye needs.

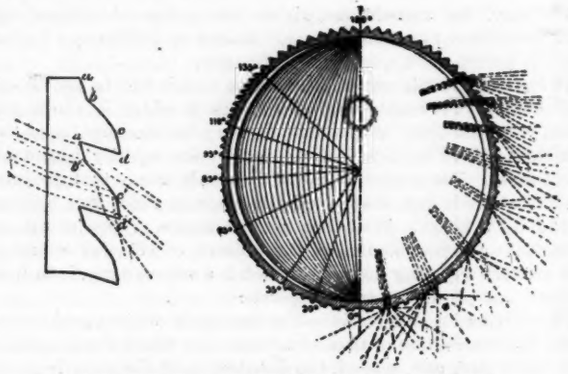

Fig. 2.—Meridianal Vertical Section of Holophane Globe.

The efficiency of a light-source is the ratio of the energy given out as light to the total energy consumed. All our present means of producing light are wasteful in the extreme, the efficiency probably never exceeding 5 per cent., and half that being nearer the average. The production of light without heat is one of the dreams of the physicist, and will probably some day be realized. But while we are compelled to use the present wasteful methods of generating light, it is the more important that care be taken to secure the greatest possible illumination from any given source. There has been almost a total neglect, on the part of those whose business it is to know, of the general principles of utilization of artificial light. It is the chief purpose of this paper to briefly set forth these principles, and review the various attempts that have been made to apply them to practical use.

The lighting engineer—a hypothetical personage whom we hope will actually exist some day—has at his disposal five different light sources—viz., the oil lamp, gas flames, incandescent gas, incandescent electric and electric arcs. With the exception of the incandescent electric, all these must be placed in a vertical position, and except the electric arc cannot be inverted. Now, it is a common idea, due to some extent perhaps to a careless statement in the text books—to wit, "from a given source light proceeds equally in all directions," that such is actually

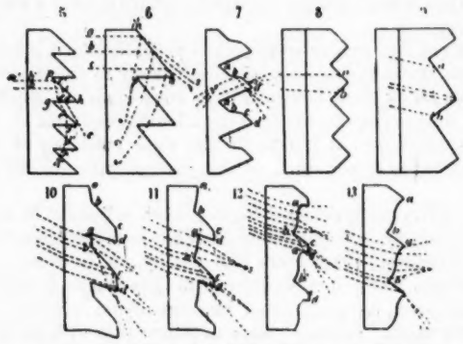

Fig. 3.—Various Forms of Profiles of Exterior Rings, Showing Reflecting and Refracting Surfaces.

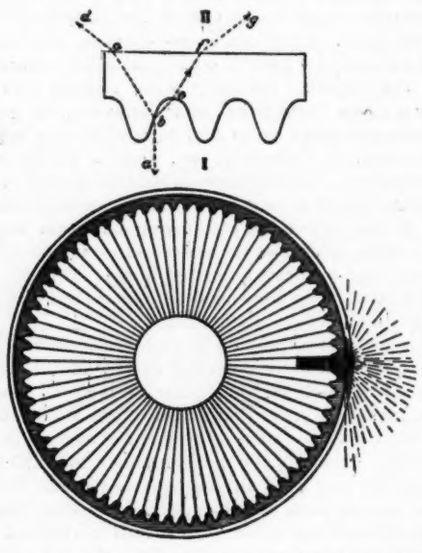

Fig. 4.—I, Equatorial Section of Holophane Globe. II, Portion of Section Enlarged, Showing Form of Interior Grooves.

the case, when in fact it is not the case at all. Each source of light distributes its rays according to its own peculiar law. These laws are most easily expressed as polar curves, which are given in Fig. 1, the plane of the curve being vertical.

It will be observed that the lights produced by gas and oil send a large part of their light upward; the direct current arc sends most its light downward, the larger part included between the angles of 30° and 50°; while the alternating arc sends its light equally upward and downward, but mostly between the angles of 50° above and below the horizontal. While the distribution from the incandescent electric is by no means uniform, it is of less importance, since the lamp may be placed at any angle. With the exception of the flat flame, the distribution of all these sources in a horizontal plane may be considered uniform.

The objects which we wish particularly to illuminate are generally below the level of the eye, as reading matter or articles being worked at with the hands. In practically all cases they are below the sources of light. The first step toward efficiency and economy will be therefore to direct the larger part of the flux of light below the plane of the

source. In exterior lighting we may consider all light above this plane as absolute waste.

The prime requisition of illumination is, as already stated, that it shall be uniform. Whatever source of light is to be used therefore a better distribution must be obtained, if economy is to be considered. Having secured this result to as great a degree as possible, the problem then becomes comparatively simple. Knowing the illuminating power of the sources to be used, the general brilliancy to be required, and the extent of space to be illuminated, the distribution of the light unit is readily determined.

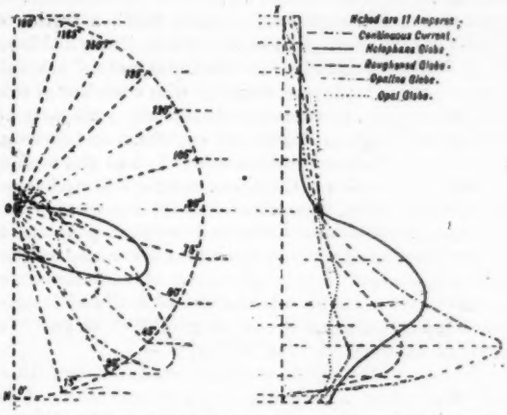

Fig. 5.—Curves of Distribution and of Flux, of Direct Current Arc, with Various Globes.

The intelligent engineer will now look to the *quality* of the light. In this regard we can do little more at present than to provide the most economical means possible for the diffusion of the luminous rays, leaving no naked light sources visible. In case arc lamps or Welsbach burners were to be used for interior lighting, he would doubtless seek to reduce the excessive blue and violet of the former, and the yellowish green of the latter, by means of suitably tinted globes.

For securing a better distribution and diffusion of the light, advantage must be taken of the well-known properties of refraction and reflection. In diverting the upward flux into the lower hemisphere, reflection is, with certain limits, the only means possible. Regular reflectors, either of silvered glass or polished metal, have long been used for this purpose; but they have several serious defects. Glass is fragile, polished metal tarnishes, and neither produce any diffusion,

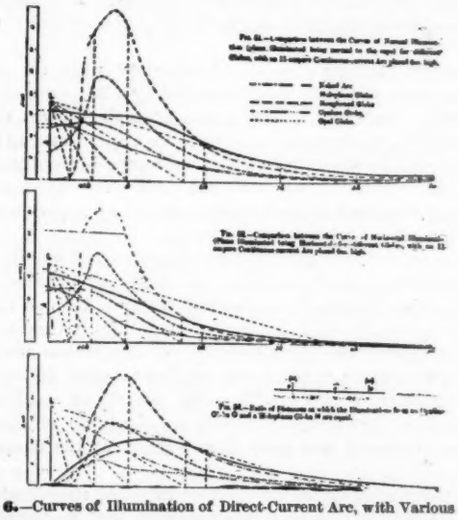

Fig. 6.—Curves of Illumination of Direct-Current Arc, with Various Globes.

but rather increase the glare. Irregular reflecting surfaces, as the so-called porcelain and white enameled metal, correct some of these defects, and give about an equal efficiency, reflecting about 80 per cent. of the incident light.

The most common method of securing diffusion, and partially correcting the distribution, is by means of globes, either roughened on the surface by sand blasting or etching, or rendered translucent and milky in the process of manufacture, "opal," or "opaline" glass. While the diffusion produced by these means is good, the method is extravagantly wasteful. Clean ground glass will absorb 30 per cent. to 50 per cent. while opal glass absorbs from 50 per cent. to 80 per cent. of the light.

Besides this loss by absorption, such glass causes an additional practical loss by diverting more light into the upper hemisphere, when used with the arc light. In this case the globe itself becomes

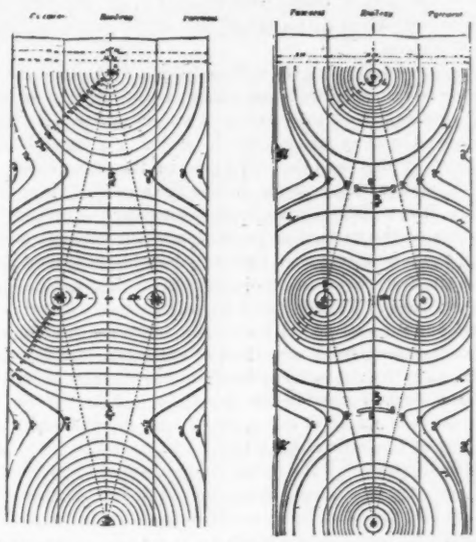

Fig. 7.—Distribution of Isolux Lines. I. With Holophane Globes. II. With Opal Globes.

the practical source of light, each point on the surface giving out light in all directions, outside the tangent plane. With the direct-current arc most of the light would fall on the lower half of the globe; but for the reason just given, this lower half would throw considerable light in the upper hemisphere which would otherwise continue its downward course. The higher the arc is placed in the globe, the greater the loss in this way.

On account of the serious objections to the means just described various attempts have been made to secure better results by the systematic use of refraction and reflection. Ribbed glass was the earliest attempt in this direction, and its use is very old. Glass of this kind was used in the electric lanterns in the streets of London. Mr. Edward Atkinson has recently revived interest in the use of such glass by applying it to the windows of factories. The results were very satisfactory, the corners and spaces between the windows being much better illuminated.

The next step was the use of two such panes placed together, with the flutings crossed at right angles, suggested by Raffard in 1881. This was simplified by Trotter in 1883, by rubbing a single sheet of glass on both sides, a method which Cooper and Richardson had suggested 10 years before. The method is still quite commonly applied to lamp "shades," or globes. Seaver has brought out a globe having interior meridianal prisms, which have the effect of widening the apparent source of light. As might be expected, they show the prismatic colors at the edges of the light. Shades having similar prisms on the outside are also to be found, and produce a similar result.

An attempt has been made to apply this principle to *blown* glass lamp chimneys, but as the process of blowing is incapable of producing appreciable variations of thickness, it is evident that such attempt must be practically useless.

The idea of giving a special form to the ribs or flutings, so as to distribute the light according to the predetermined law, was suggested by Fresnel more than 50 years ago, and has been very highly developed for lighthouse purposes. Comparatively little attention, however, has been given to applying the principle to the problem of securing a better distribution for general illumination.

In 1883 Mr. A. P. Trotter, an English engineer, devised a lantern with panes of glass having flutings, the profiles of which had been calculated with a view to giving uniform illumination on a horizontal plane. Although the results were remarkably good, the expensiveness of the device seems to have prevented its adoption. More recently Fredureau has constructed globes with simple prismatic or parabolic external zones, simply to reflect as much of the light downward as possible. They are properly reflectors and produce no diffusion.

The latest attempt of this kind is the globe brought out by Messrs. Blondel and Psaroudaki, of Paris. These globes are provided with horizontal exterior rings and vertical meridianal groovings, the profiles of

both being calculated mathematically, according to the laws of optics, so as to give the best distribution, with ample diffusion.

The two sets of grooves and projections are so formed as to make the entire globe appear luminous, from which fact the inventors have given them the name "holophane," signifying wholly luminous. So ingeniously have the laws of optics been applied to the practical solution of this important problem that a description of the globes will doubtless be of general interest.

The method of designing them is as follows: The general contour of the globe or envelope is first determined, which may be of any desirable form consistent with the process of manufacture. As an example let us suppose that a spherical form is chosen, Fig. 2. The location of the source of light is then decided upon, in this case being generally placed a little above the equator. Since the source of light has more or less surface, it is sufficiently accurate to consider the incident rays on a small section of the surface as parallel, and the surfaces of the section planes. The problem requires that we should deflect each beam in the most advantageous direction, and at the same time spread it out so as to secure diffusion. Theoretically we might accomplish this by giving each section of the exterior surface a simple, convex or concave profile. But, by such construction, a portion of the beam, striking the surface at a large angle, would suffer a considerable amount of reflection, the reflected portion being lost in the upper hemisphere. In order to avoid this loss a surface placed at the angle of total reflection $b'c'$ is substituted for a part of the refracting curves. By properly calculating these curves, which is done by the use of mathematical formulæ too long to be given here, the beam may be spread out so as to secure the desired distribution and diffusion, with a minimum of loss. In a similar manner the entire surface of the globe may be divided into such rings, each having its profile so calculated as to distribute the light over the same solid angle, and hence appearing luminous in the line of sight to an eye situated anywhere within the angle. The dividing lines $a\,d$ between the rings are made as nearly as possible in the direction of the incident rays. Theoretically, each ring should have a different form, due to the different direction of the incident rays; but in practice it is sufficient to divide the periphery into a number of zones, each zone having a special form of ring, as shown at the left side of the section, Fig. 2. Near the top of the globe the rings have the form of doubly reflecting prisms, which deflect the light downward through the lower portion of the globe. Great variety in the profile of the rings is possible. Some characteristic forms are shown in Fig. 3.

A globe thus constructed with only horizontal groovings or rings will give only vertical spreading, and so appear luminous only in a vertical meridian. To secure lateral spreading of the light, the interior surface is formed of a series of meridianal grooves, from top to bottom, Fig. 4. These grooves all have the same profile, since all sources of light give out their rays with practical uniformity in all directions laterally. The curvature of these interior flutings is therefore so calculated as to spread the beam out as nearly as possible over a solid angle of 180°, *i. e.*, tangent to the surface. Furthermore, the curve is calculated to distribute the light according to the law of cosines, so that each meridian shall appear equally luminous when viewed from every point. Of the many curves which would fill these conditions theoretically, the one shown has been selected as having the greatest practical advantage.

The effect of diffusing globes is to make the source of light appear larger. If the diffusion is perfect, the entire surface of the globe becomes luminous, as in the case of opal and ground glass. Of all the variously ribbed and corrugated globes made of clear glass, the holophane is the only one which attains this perfection.

Photometric comparison of the results obtained with the various globes when used with a direct current arc lamp have been made by Blondel and others, the results of which are very instructive. Fig. 5 gives the curves of distribution, and also of flux with an arc used with the several globes named. Fig. 6 gives the curves of illumination. Fig. 7 gives the distribution of the isolux lines on the pavement of the Paris boulevards under two different kinds of globes.

From these curves it will be seen that a better distribution, coupled with a satisfactory diffusion, is secured, with considerably less loss of light, by the holophane globe than with either ground glass or opal globes. It is to be hoped that experiment and investigation on these lines will lead to even better results, and to a more general appreciation of the importance of a proper use of our splendid modern light sources.

THE regular semi-annual dividend of 5 per cent., by the Cambridge (Mass.) Gas Light Company, is payable since the 1st inst.

Superheated Steam Engine Trials.

At the last ordinary meeting of the English Institution of Civil Engineers, held on Tuesday, January 12, Mr. John Wolfe Barry, C.B., the President, in the chair, the paper read was on "Superheated Steam Engine Trials," by Professor William Ripper, M. Inst. C.E.

The author pointed out that the use of superheated steam had been in abeyance for the past 30 years, during which time a continually increasing gain in steam engine efficiency had followed the development of the multiple-expansion engine, and the increase of steam pressures. The limit having been now nearly reached in this direction, engineers were again reverting to superheating, from which a further considerable increase of efficiency might be looked for. Trials had been carried out on a 17 indicated horse power "Schmidt motor," a single-acting, simple, non-condensing engine, supplied with superheated steam from a Schmidt superheater, to determine the steam consumption of the engine working with various degrees of superheat, and at temperatures considerably beyond those usually employed; and also to find to what extent the dryness fraction of the steam, and the heat exchange between it and the cylinder walls, were affected by the superheat.

The heat expended in superheating reduced the amount of heat employed in evaporation of water, but the heat so diverted for the purpose of superheating was shown to be productive of a considerable gain in thermal efficiency. Thus an expenditure of 5, 10 and 15 per cent. of the furnace heat to superheat gave a net gain of 12, 38 and 70 per cent. respectively of the work done for heat supplied.

When the load on the engine was fairly constant very little regulation of the superheat was necessary, and the temperature of the superheated steam in the coils remained remarkably steady. If the load on the engine was reduced, the temperature of the steam in the superheater immediately began to fall, though there was no appreciable change in the condition of the fire; on the other hand, if the load was increased, the temperature of superheat increased also. If superheated steam was desired at the engine, then the superheat being once taken up by the steam should have its high temperature preserved by all possible means till it reached the admission valve of the engine.

It was stated that no important gain could be theoretically expected from superheating, the actual gain in practice being due to the more or less complete removal of the loss by cylinder condensation. When steam was superheated it was in a more stable condition than without superheat, and if the steam contained sufficient excess heat, the steam in the cylinder could be rendered dry at cut-off and at release. This had been accomplished in certain of the trials described in the paper. Superheating thus removed the principal source of loss of heat in the cylinder, namely, water at release, and it reduced also the amount of the heat exchange between the steam and the cylinder walls to a minimum.

The effect of varying degrees of superheat upon the steam consumption per unit of power was illustrated by a large number of trials under varying conditions. Taking one example, it was shown that steam at 120 lbs. per square inch pressure superheated to 674° F. on entering the engine, reduced the steam consumption from 38.5 lbs. without superheat, to 17.05 lbs. per indicated horse power per hour, the rate of decrease of steam consumption with increase of superheat being approximately uniform within certain limits.

It was pointed out from the indicator diagrams how rapidly the superheat disappeared on admission of the steam to the cylinder, and how few were the cases in which the steam in the cylinder was found to be superheated at cut-off, though admitted in a highly superheated condition. It appeared from these experiments that unless the degree of superheat of the steam entering the engine reached at least 200° F. above its normal temperature with a late cut off, or a still higher degree of superheat for an earlier cut-off, the condition of the steam in the cylinder at cut-off was that of wet steam at the temperature of saturation.

In order that the steam in the cylinder might be superheated during expansion and dry at release, it was necessary that its temperature on entering the engine should be about 300° F. above the temperature normal to its pressure. When the steam was dry at release it was superheated at cut off from 50 to 100° F., finally falling at end of about three expansions to the temperature of saturated steam. For a small increase in the number of expansions the temperature at cut-off rapidly fell to that of saturated steam.

The author considered superheating not as a means of obtaining a thermal efficiency in any way proportional to the temperatures used, but as a device for realizing as far as possible the full thermal efficiency of saturated steam, by rendering the cylinder practically non-conduct-

ing. The practical difficulties supposed to be associated with the production and use of superheated steam had been satisfactorily overcome. Experience had shown that with ordinary care as to purity of feed water, superheated tubes after long periods of severe work showed no signs of burning, scaling or injury of any kind. With the greatly improved quality of lubricating oils no trouble need arise with the lubrication of superheated steam engines.

The best results could be obtained when the steam was supplied at about 650° F. at the engine. It was important to use good non-conducting material to maintain the high temperature of the steam in its passage to the engine. The best results in these trials had been obtained in association with a high range of pressure in one cylinder with a late cut off. Any cause which tended to increase initial condensation in the cylinder with saturated steam tended also with superheated steam to absorb the superheat and to neutralize its useful effect in the cylinder. Superheated steam at high temperatures might be safely and advantageously used in double-acting engines. Many such engines were now at work or in course of construction.

The point requiring chief consideration in the design of engines to work with superheated steam was the steam admission arrangements. The steam admission valve, being subjected to the maximum temperature, should be practically frictionless, so as to remove the necessity for its lubrication.

The paper was accompanied by an appendix of tables giving the results of a large number of trials, and accompanied by diagrams illustrating the effects of superheating on steam consumption, dryness fraction of steam during expansion, heat interchange between the steam and the cylinder walls, work done per pound of steam, and thermal efficiency.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE following are the proposals submitted by the named Companies, of Brooklyn, N. Y., for the public lighting of that city, in response to the request of the Commissioner of Public Works (Mr. Willis) for such proposals. Brooklyn Union Gas Company:

One-Year Contract.—Street lamps, 3-foot burners, $18.25 per lamp; 4-foot, $22.90; 5-foot, $27.54. Gas to public buildings, $1 per 1,000; to private consumers, $1.24.

Three-Year Contract.—Street lamps, 3-foot burners, $18.25, $17.75 and $17.25, respectively; 4-foot burners, $22.90, $22.40 and $21.90; 5-foot burners, $27.54, $27.04 and $26.54. To public buildings, $1, 99 cents and 98 cents. Private consumers, $1.23, $1.21 and $1.19.

Five Year Contract.—Street lamps, 3-foot burners, $18, $17.50, $17, $16.50, $16; 4 foot burners, $22.58, $22 08, $21.58, $21.08, $20.58; 5-foot burners, $27.16, $26.66, $26.16, $25.66, $25.16. To public buildings, $1, 97½ cents, 95 cents, 92½ cents, 90 cents; to private consumers, $1.20, $1.15, $1.10, $1.05, $1.

Ten-Year Contract.—Street lamps, 3-foot burners, beginning at $18 and ending at $15.75; 4-foot burners, beginning at $22.58 and ending at $20.33; 5-foot burners, beginning at $27.16 and ending at $24.91. To public buildings, beginning at 99 cents and ending at 90 cents; to private consumers, $1.21, $1.17, $1.13, $1.09, $1.05, $1.04, $1.03, $1.02, $1.01, $1.

The bids submitted by the Flatbush Gas Company, which has the right to supply gas in the annexed districts formerly known as Flatbush, Parkville, Greenfield, etc., were these:

One-Year Contract.—Public lamps, 3-foot burners, $20; 4 foot, $25; 5-foot, $30. To public buildings, $1.20; to private consumers, $1.25.

Three-Year Contract.—Public lamps, 3-foot burners, $20, $19.75, $19.50; 4-foot, $25, $24.75, $24.50; 5-foot, $30, $29.75, $29.50; Welsbach lamps, $35, $34.50, $34. To public buildings, $1.19, $1.17, $1.15; to private consumers, $1.24, $1.22, $1.20.

Five-Year Contract.—Public lamps, 3-foot burners, $20, $19.75, $19.50, $19.25 and $19; 4-foot, $24.75, $24.50, $24.35, $24 and $23.75; 5-foot, $29.75, $29.50, $29.25, $29 and $28.75; Welsbach lamps, from $35 to $33. To public buildings, $1.19, $1.17, $1.15, $1.13, $1.11; to private consumers, $1.22½, $1.20, $1.17½, $1.15, $1.12½.

Ten-Year Contract.—Public lamps, 3 foot burners, $20, $19.87½, $19.75, $19.62½, $19.50, $19.37½, $19.25, $19.12½, $19, $18.87½; 4-foot, beginning at $24.75 and ending at $23.62½; 5-foot, from $29.75 to $28.62½. To public buildings, from $1.19 to $1.10; to private consumers, from $1.24 to $1.10½.

THE proposals will be advertised for six days (from Friday, January 29, to Friday, February 5), after which they will be transmitted to the Common Council, which body will determine the term the contract is to run and authorize the performance of the same.

THE proprietors of the Galveston (Tex.) Gas Company have ordered a reduction in the rate for gas supplied on account of cooking, heating and power to $1.50 per 1,000 cubic feet, the concession to go into effect March 1.

THE office headquarters of the Joliet (Ills.) Gas Light Company have been removed to the Fish Building, corner of Van Buren and Chicago streets. The premises have been fitted up in good style—in fact, the change has been perfected under the plan of action that always characterizes Mr. Copley's projecting and Manager Brush's perfecting.

AT a joint meeting of the Committees on Light and Finance, of City Councils of Richmond, Va., the propositions submitted by the Richmond Gas Company, and by Messrs. Flournoy and Marshal, for the leasing of the Richmond municipal gas plant and its subsequent operation on private account, were considered. After a prolonged discussion, a motion by Mr. Witte, that "the papers be returned to the Council, with the indorsement that it is inexpedient for the city to dispose of its gas plant at this time," was adopted.

AT the annual meeting of the Bristol (R. I.) Gas Light Company the following officers were elected: Directors, R. S. Franklin, Hezekiah W. Church, James C. Swan, J. H. Manchester and W. C. Wardwell; President, H. W. Church; Secretary, Treasurer and Superintendent, J. H. Manchester.

THE proprietors of the Marblehead (Mass.) Gas Light Company have announced the following rate schedule, the concession (which amounts to about 10 per cent. from the prior schedule) to date from Feb. 1st.

Monthly Consumption.	Net per 1,000 Cubic Feet.
Bills of $1 or less	$3.00
" over $1, up to and including $3	2.50
" over $3, up to and including $18	2.25
" over $18	2.00

AT Danvers, Mass., the gas supply of which is also controlled by the people in interest at Marblehead, a similar rate table has gone into effect.

AT the annual meeting of the Youngstown Gas Company, the Youngstown Electric Light Company and the Mahoning Electric Light Company, all of Youngstown, Ohio, the officers chosen were: Directors, John C. Wick, George Tod, Frank Hitchcock, Thomas E. Davey, J. H. Clark, E. L. Brown and B. P. Holmes; President, Frank Hitchcock; Secretary and Treasurer, P. T. Caldwell; General Manager, B. P. Holmes.

THE proprietors of the Milwaukee (Wis.) Gas Light Company, during the last severe cold spell, donated 100 tons of coke for the use of the poor. The fuel material was placed at the disposal of the Associated Charities and the Hebrews Relief Society (75 tons to the former and 25 tons to the latter) for distribution. The Company also agreed to deliver the coke free of charge at the points named by the charitable organizations.

THE sum paid into the City Treasury of Omaha, Neb., by the Omaha Gas Mfg. Company, on account of its receipts for gas during 1896, amounted to $7,410.06.

THE Meadville (Pa.) Gas Company has good reason to be satisfied over the results that have followed its occupation of handsomely fitted up office and showroom quarters in the premises, 272 Richmond Block.

AT the annual meeting of the Oneonta (N. Y.) Gas Light Company the officers elected were: Directors, F. D. Miller, M. C. Keyes, M. L. Ford and A. L. Mendel; President, F. D. Miller; Vice-President, M. L. Keyes, Secretary, G. A. Lane; Treasurer, M. L. Ford.

AT the annual meeting of the shareholders in the Grand Rapids (Mich.) Gas Light Company the reports showed that the output of gas for the past twelvemonth exceeded that of the previous year by 8 per cent., and that 788 fuel appliances had been installed, 582 of which were of the gas cooking type. Welsbach lamps to the number of 3,000 had also been placed. The Company's proposed new holder, rated to a capacity of 1,000,000 cubic feet, which will be constructed the coming spring, is to be located at the corner of Oakland and Wealthy avenues. The Directors chosen were: E. McMillin, N. L. Avery, Thos. J. O'Brien, A. G. Hodenpyl, H. Idema, J. M. Barnett, J. B. Pantlind, Lester J. Rindge and H. D Walbridge.

THE probability is that the reorganization of the Macon (Ga.) Gas Light and Water Company will be completed this spring. Bond hold

ings, to an amount fully equal to three-quarters of the issue of such total debt, have assented to the reorganization plan proposed, and as the Messrs. Wood, of Philadelphia, are unitedly in favor of the scheme outlined, we might say that certainty would better express the spring prospect rather than probability. At the bondholders' meeting in Macon, held perhaps over a fortnight ago, Receiver Tinsley came in for much encomium about the cleverly safe way he had managed the properties since these were put under his control.

THE Kansas City (Mo.) gas war is over, no matter whatever else has been, or is to be, brought about respecting the attitude of the competing Companies towards each other. The lesson seems to have been a severe one; but, as all's well that ends well, the end in this case may have justified the means.

AT the annual meeting of the Wooster (Ohio) Gas Light Company the following officers were chosen to control the Company's affairs for the ensuing year: Directors, J. H. Kauke, J. M. Walker, John McSweeney, C. S. Frost and Francis Taggert; President, John H. Kauke; Secretary and Superintendent, C. W. Kauke.

IN a bill providing for the creation of a department to supervise the gas fitting of buildings in Boston it is stipulated:

Section 1.—No person, firm or corporation shall engage in or work at the business of gas fitting in the city of Boston, after September 1, 1897, either as employer or as a journeyman, unless such person, firm or corporation has received a license therefor.

Section 2 provides that any person or firm desiring to engage in the gas fitting business must make application to the Building Commissioner before September 1, 1897. The applicant shall be examined as to his qualifications by a Board of Examiners, consisting of the Building Commissioner and Fire Commissioner, ex-officio, and a third member to be chosen by these two, who shall be a practical gasfitter of five years' experience, and shall be allowed $5 for each actual day of service on the Board. This Examining Board, according to Section 4, shall designate time and place for examinations. The license fee of any employer of gas fitters shall be $2, and the fee from a journeyman shall be 50 cents. Section 5 provides that the Building Commissioner shall appoint, before October 1st, 1897, at least four inspectors for gasfitting; thereafter such additional number as the City Council may by ordinance determine. These inspectors shall receive compensation to be determined by the Building Commissioner, subject to the approval of the Mayor, and such inspectors shall hold office until removed by such Commissioner, with the approval of the Mayor, for malfeasance, incapacity or neglect of duty. Section 7 provides that, on and after September 1, 1897, no building shall be piped or fitted for gas, nor shall any repairs be made in such piping or fittings nor fixtures placed, unless a permit shall be granted therefor by the Building Commissioners. Any person violating any of the provisions of this act shall be deemed guilty of a misdemeanor, and shall be subject to a fine not exceeding $100 for each and every offense, and if such person has received a license under the act it may be revoked by the Building Commissioner, and said Commissioner may forbid him to engage in or work at the business of gas fitting in the city of Boston for a period not exceeding one year. It is further specified that the act will become fully effective September 1st, 1897.

AT the annual meeting of the Sidney (Ohio) Gas Light Company the officers elected were: Directors, E. R. Leland, E. W. Hanley, Henry Flesh, S. W. Maxwell and A. J. Hess; President, S. W. Maxwell; Secretary, E. M. Hanley.

A BRIEF note from "Observer," dated the 2d inst., informs us that Mr. T. J. Whidden, for many years prominent in the affairs of the East Boston (Mass.) Gas Light Company, died at his home, 37 Upton street, Boston, on the morning of January 30th. Deceased was born in Portsmouth, N. H., June 17th, 1817, and shortly after attaining his majority removed to Boston, where the balance of his actively successful life was spent. He amassed a fortune in the building business, and his reputation was that of a man who had achieved success by hard work and fair trading. In addition to his connection with the East Boston Gas Light Company, he was a Director of the Boston Safe Deposit and Trust Company, a Director of the Eagle Bank, and was President of the Boston Storage Warehouse Company. He was a member of the Boston Board of Aldermen from 1876 to 1878. Four sons survive him.

ANOTHER instance of the desire of "disinterested" capitalists to get a good paying business, either one way or another, is shown by an application recently made to the Connecticut Legislature for a bill incorporating the Consumers Gas Light Company, the projectors of which propose to supply gas in the city of New Haven and the towns contiguous thereto. Senator Tuttle is the nominal sponsor of the measure, and the incorporators are said to be Messrs. W. H. H. Hewitt, A. B. Dunham, Theophilus Eaton and Grove J. Tuttle.

THE following interesting matter, in the instance of the litigation over a mortgage issue of $1,000,000 by the Detroit Gas Company, was forwarded by a correspondent:

"Judge Carpenter has handed down an important decision in the $1,000,000 mortgage foreclosure case of Alexander Lewis and Jerome Croul, Trustees, against Camille Weidenfeld and the other New York stockholders of the Detroit Gas Company, the Court deciding in favor of the Trustees. The suit was brought to foreclose the mortgage on the property and plant formerly owned by the Detroit Gas Light Company, now the property of the Detroit Gas Company. The mortgage was given in February, 1893, and there is now about two years' interest due. Judge Carpenter, in his decision of 14 type-written pages, takes up three legal propositions, and, after reviewing the history of the old Gas Company since its organization, about 50 years ago, decides each point separately. The questions were: Should the amount secured by the mortgage be reduced for the reason that the right to lay gas pipes in the streets was not so valuable as represented at the time of the sale? What property did the mortgage cover? Was Weidenfeld personally responsible for the indebtedness secured by the mortgage?

"Mr. Weidenfeld and his associates claimed that the purchase of the Detroit Gas Light Company's plant and property was made by the buyers, relying upon certain rights to lay gas pipes in accordance with a contract with the city, which was formed in 1851, but that as a matter of fact these rights were surrendered 10 years later. The purchasers, however, did not contend that these rights were given up in stated terms, only that they were not consistent with the contract and that an intended surrender should be inferred. This inference was justified, it was claimed, because the Gas Company had established a plant and laid a good deal of pipe, and the property would have been worthless if used for any other purpose. Judge Carpenter, in holding that the intent of the old Company to surrender its right to supply gas under the contract with the city should not be inferred from language of doubtful import, said: 'It is more probable that the parties to the contract expressed what would otherwise be implied, than that they used language in a sense contrary to its well settled meaning, and that they themselves placed a wrong construction of this language for 27 years. As the regulations in the contract of 1861 on the method of exercising the rights granted in 1851 are not claimed to impair the value of these rights, it must be concluded, therefore, that the defendants' claim for recoupment must be denied.'

"Relative to the property covered by the mortgage the court stated: 'It clearly covers all the property, pipes, franchises, contracts and privileges of the Detroit Gas Light Company transferred to Weidenfeld. The mortgage contains this clause: 'Also all improvements and additions of every name and nature made by Weidenfeld to the plant and apparatus for making and liberating gas, while any part of the money secured remains unpaid.' At the time of the sale, the Detroit Gas Light Company was supplying gas to that part of the city west of Woodward avenue. Soon afterward the Detroit Gas Company acquired all the property and rights formerly owned by the Mutual Gas Company and by the Michigan Gas Company. A controversy arose with the city of Detroit concerning street rights, which was adjusted in 1893. The Detroit Gas Company has extended the pipes connected with the manufactory sold Weidenfeld to various streets in the northwestern part of the city. It has built in its manufactory, under a contract which gives it an undivided half interest therein, an apparatus for manufacturing and supplying gas to railway cars, known as the Pintsch gas system.

"It is claimed by the complainants and denied by the defendants that the mortgage covers so much of the grant of the street rights of 1893 as are necessary to the operation of the plant, the extension of pipes to the northwest part of the city, and the Pintsch gas system. Defendant has undertaken to surrender the rights under the contract of 1851, as a consideration for the grant of rights in 1893. Surely defendant cannot insist that it had the right to exchange a part of the mortgaged property, without which the remainder would be worthless, and that thereafter the mortgage neither carried the property exchanged nor the property acquired. When the defendant, the Detroit Gas Company, surrendered the mortgaged rights to the city, it estopped itself from asserting that those rights were subject to complainants' mortgage, and thereby gave the latter the right to accept the acquired rights, in place of those relinquished. It is quite clear to me that the extension of pipes referred to is an addition for distributing gas. It is argued that the description in the mortgage quoted does not cover the Pintsch apparatus, because it is distinct in itself, and not a part of the mortgaged plant. This fact is not decisive. It was an addition of some kind or nature to the plant for making and distributing gas, and, as such, is covered by the terms of the mortgage.' "Upon the question of Weidenfeld's personal responsibility for the mortgaged indebtedness, Judge Carpenter says: 'By the contract of sale, defendant, Weidenfeld, expressly agreed to pay the purchase price, and to secure the deferred payments by a purchase money mortgage. The mortgage itself contains no covenant that the mortgagor will pay the secured indebtedness, but it contains a provision that on payment of the amount thereby secured, on dates therein specified, until the whole sum secured thereby shall be fully paid, according to the agreements for the payment of the purchase price in the contract for the sale of the property, and on the performance of the covenants therein contained, then the obligation was to be void. I think that defendant Weidenfeld's obligations to pay the mortgaged indebtedness continued after the execution of the mortgage.'"

The Market for Gas Securities.

The city gas share market presented no particularly marked features during the week. Consolidated is easier, at 148 to 149, and New York and East River is also a trifle weaker. On the other hand, Standard preferred is 3¼ points higher. The first hearing by the Committee on Miscellaneous Corporations of the Senate on the merits of the Cantor bill, was held yesterday (Thursday), and some arguments by those in its favor were advanced. Notable among those who advocated it were Prof. Bemis and Lawyer H. M. Cross. The hearing was adjourned to Feb. 18, when the representatives of the Companies are to present their case. The arguments by the bill's supporters were of the usual nature; nothing new was advanced by them.

Brooklyn Union is steady, and the bonds are 108 to 108½. Chicago gas is somewhat weaker, but the decline is purely in sympathy with the general market conditions. Lacledes are also dull.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

Feb. 8.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,480,000	100	148	149
Central	500,000	50	195	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	230	..
Bonds, 6's	1,000,000	1,000	105	.
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	225	.
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	85	..
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	46¼	46¾
Preferred	2,000,000	100	76	77
Bonds 1st 5's	3,500,000	1,000	104¼	108½
" 1st Con. 5's	1,500,000	..	95	96
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	80	82
Preferred	5,000,000	100	107½	109
Bonds, 1st Mortgage, 5's	1,500,000	1,000	108	..
Yonkers	299,650	50	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	90	93
" " Bonds (5's)	15,000,000	1,000	108	108½
Bay State	15,000,000	50	11	11¾
" Income Bonds	2,000,000	1,000	..	85
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	..	85
2d " " "	3,000,000	1,000	70	72
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	...	95	..
Chicago Gas Co.	25,000,000	100	77½	77¾
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,000,000	..	68	70
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	..	75
" Bonds	600,000	1,000	100	102
Cincinnati G. & C. Co.	8,500,000	100	199¾	200½
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	61¼	61¾
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,400,000	..	..	..
Detroit	4,000,000	..	22	..
" Con. Bonds	4,312,000	..	78	78½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	82	84
" Bonds	2,000,000	..	91	93
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	130	135
" Bonds, 6's	2,650,000	..	105	107
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	84	88
Bonds	1,000,000	1,000	92	94
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	23¼	24½
Preferred	2,500,000	100	70	75
Bonds	9,084,400	1,000	94¼	94½
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	93	98
Bonds, 6's	4,000,000	.	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	53½	54
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	83	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	97¾	98¾
St. Paul Gas Light Co.	1,500,000	100	67½	70
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	59	61
Bonds, 5's	3,556,000	.	90	91
Wilmington, Del.	500,000	50	180	182

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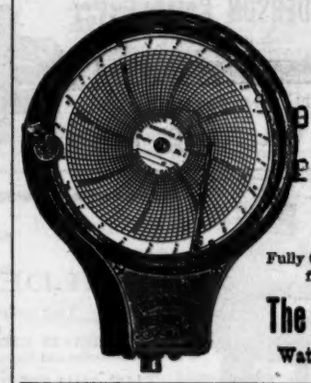

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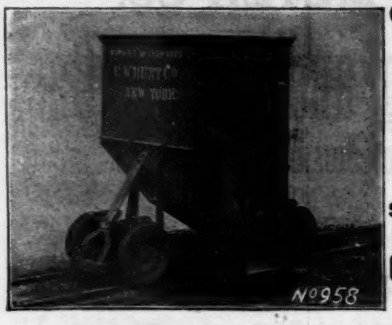

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INJUNCTION ISSUED AGAINST INFRINGERS.

On September 23d the United States Circuit Court for the Southern District of New York granted an injunction restraining and enjoining the further infringement of our Welsbach patent. READ IT.

UNITED STATES CIRCUIT COURT,
Southern District of New York.

WELSBACH LIGHT COMPANY,
vs.
A. LIEBES.
} IN EQUITY.

The President of the United States,

To A. LIEBES, and his servants, agents, attorneys and workmen, GREETING:

WHEREAS, It has been represented to us in our Circuit Court of the United States for the Second Circuit and Southern District of New York, that Letters Patent of the United States No. 438,125, were issued in due form of law on the 7th day of October, 1890, to Carl Auer von Welsbach, assignor of the complainant, then known as "Welsbach Incandescent Gas Light Company of New Jersey," and that the complainant herein is the owner of said Letters Patent, and that you, the said A. Liebes, have infringed the rights secured by the aforesaid Letters Patent, by making, using and selling to others to be used, incandescent devices for gas burners, embodying and containing the invention and improvements described and claimed in said Letters Patent No. 438,125.

NOW, THEREFORE, We do strictly command and enjoin you, the said A. Liebes, and your attorneys, agents, servants and workmen, under the penalties which may fall upon you in case of disobedience, that you forthwith and forever desist from directly or indirectly making, or causing to be made, delivering, vending, or causing to be sold, offering for sale, using, or causing to be used in any manner, any incandescent devices for gas burners, like, or similar to those which you have heretofore made, used or sold, containing or embodying the invention and improvements described in said Letters Patent No. 438,125, and claimed in the claim thereof, and from counterfeiting or imitating the said invention or improvements or any part or parts thereof, and from in any manner or way whatsoever, violating or infringing the said Letters Patent No. 438,125 and the claim thereof, and from doing, or causing to be done, any other act or thing whatsoever in infringement of the said Letters Patent No. 438,125.

WITNESS, The Honorable Melville W. Fuller, Chief Justice of the United States, at the City of New York, in the Southern District of New York, this twenty-fourth day of September, A. D., 1896.

(SEAL.) JOHN A. SHIELDS, Clerk.

(Endorsed) U. S. Circuit Court, Southern District of New York, in Equity.—Welsbach Light Company vs. A. Liebes. Injunction.

A Copy of a Writ of Injunction this day issued out of my office. JOHN A. SHIELDS, Clerk.

We shall proceed against all infringers; manufacturers, dealers and users being equally liable to injunction and damages. The decree of the court awarding the injunction also awards profits and damages. Do not be misled or deceived by guarantees offered by infringers, as such guarantees will not protect you against suit, injunction and damages. For your own protection see that you get the genuine Welsbach light. All other incandescent gas lights are infringements.

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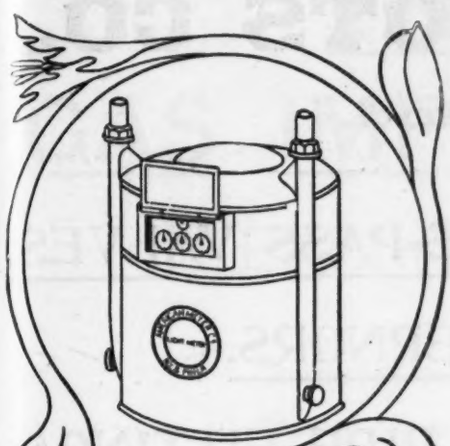

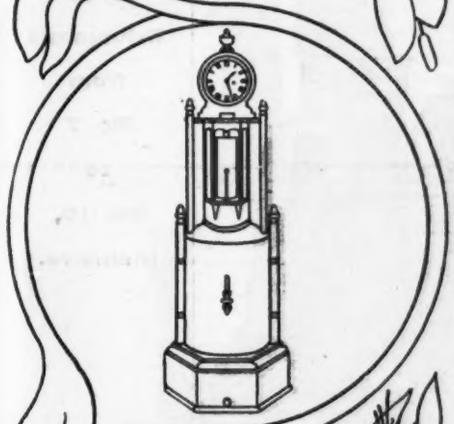

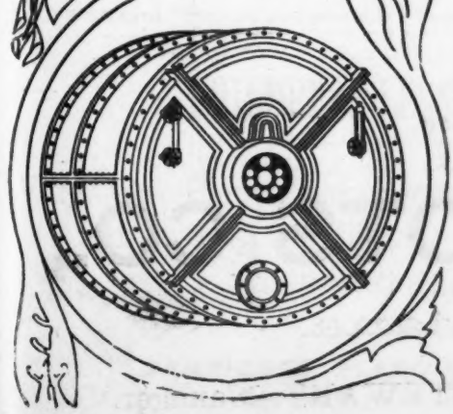

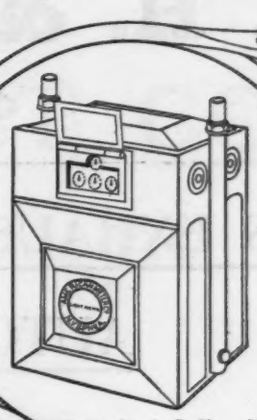

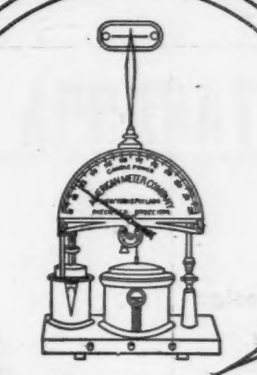

PUBLIC LIGHTING TABLE.

FEBRUARY, 1897.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Mon.	1	5.50 PM NM	6.10 AM	5.05	6.15
Tue.	2	5.50	6.10	5.05	6.15
Wed.	3	5.50	6.10	5.05	6.15
Thu.	4	5.50	6.10	5.05	6.15
Fri.	5	5.50	6.10	5.10	6.10
Sat.	6	9.40	6.10	5.10	6.10
Sun.	7	10.40	6.00	5.10	6.10
Mon.	8	11.40	6.00	5.10	6.10
Tue.	9	12.40 AM FQ	6.00	5.10	6.10
Wed.	10	1.40	6.00	5.10	6.10
Thu.	11	2.40	6.00	5.10	6.10
Fri.	12	3.30	6.00	5.20	5.55
Sat.	13	4.10	6.00	5.20	5.55
Sun.	14	4.50	5.50	5.20	5.55
Mon.	15	No L.	No L.	5.20	5.55
Tue.	16	No L. FM	No L.	5.20	5.55
Wed.	17	No L.	No L.	5.20	5.55
Thu.	18	6.10 PM	8.30 PM	5.20	5.55
Fri.	19	6.10	9.40	5.30	5.55
Sat.	20	6.10	10.50	5.30	5.55
Sun.	21	6.20	12.10 AM	5.30	5.55
Mon.	22	6.20	1.30	5.30	5.55
Tue.	23	6.20 LQ	2.40	5.30	5.55
Wed.	24	6.20	3.50	5.30	5.55
Thu.	25	6.20	4.40	5.30	5.55
Fri.	26	6.20	5.30	5.30	5.45
Sat.	27	6.20	5.30	5.30	5.45
Sun.	28	6.20	5.30	5.30	5.45

TOTAL HOURS LIGHTING DURING 1897.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	233.00	January	423.20
February	187.20	February	355 25
March	202.00	March	355.35
April	170.40	April	298.50
May	163.00	May	264.50
June	140.40	June	234.25
July	151.40	July	243.45
August	167.30	August	280.25
September	174.40	September	321.15
October	200.00	October	374.30
November	205.20	November	401.40
December	220.10	December	433.45
Total, yr.	2216.00	Total, yr.	3987.45

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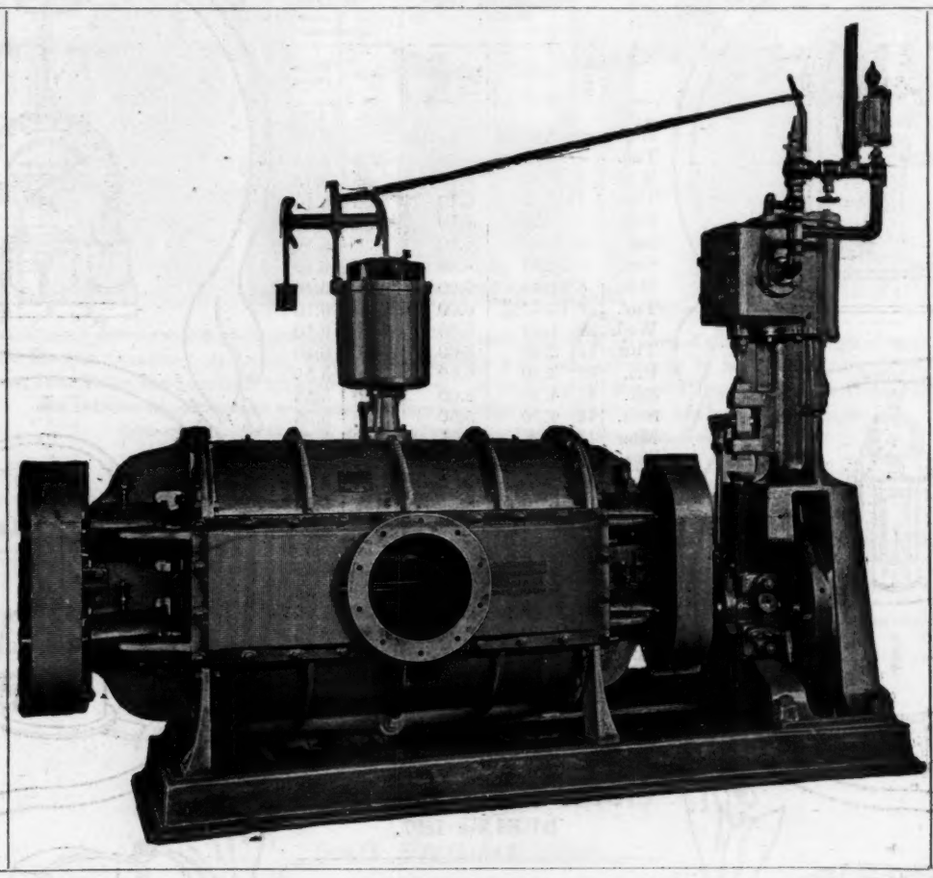

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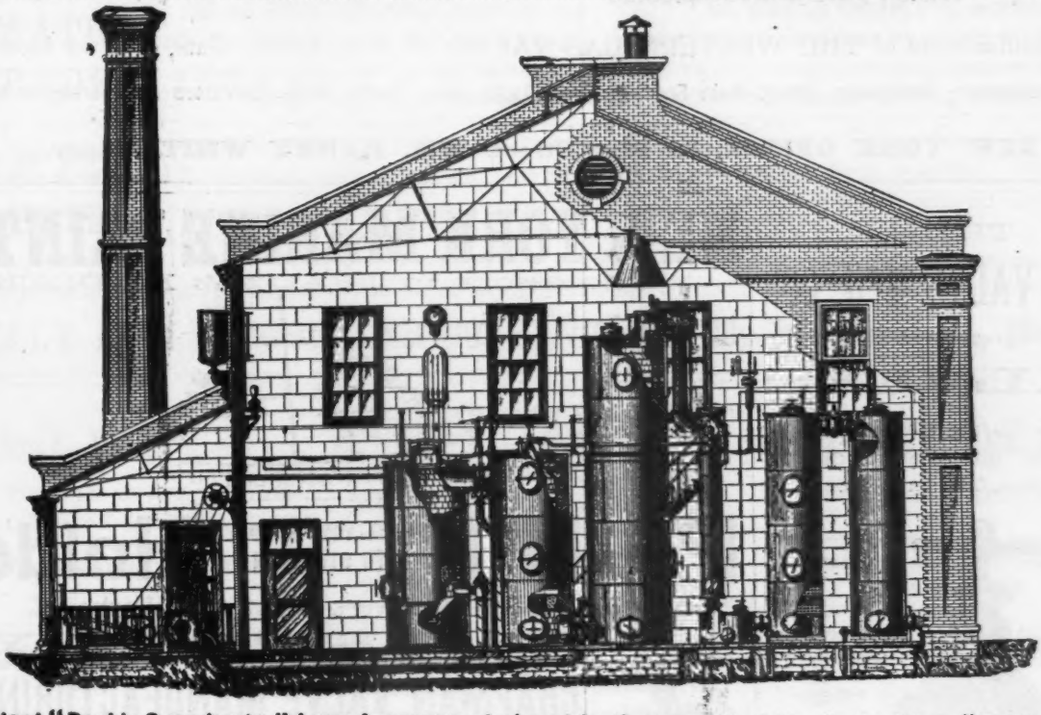

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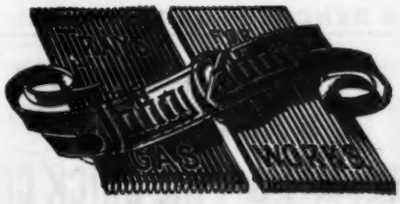

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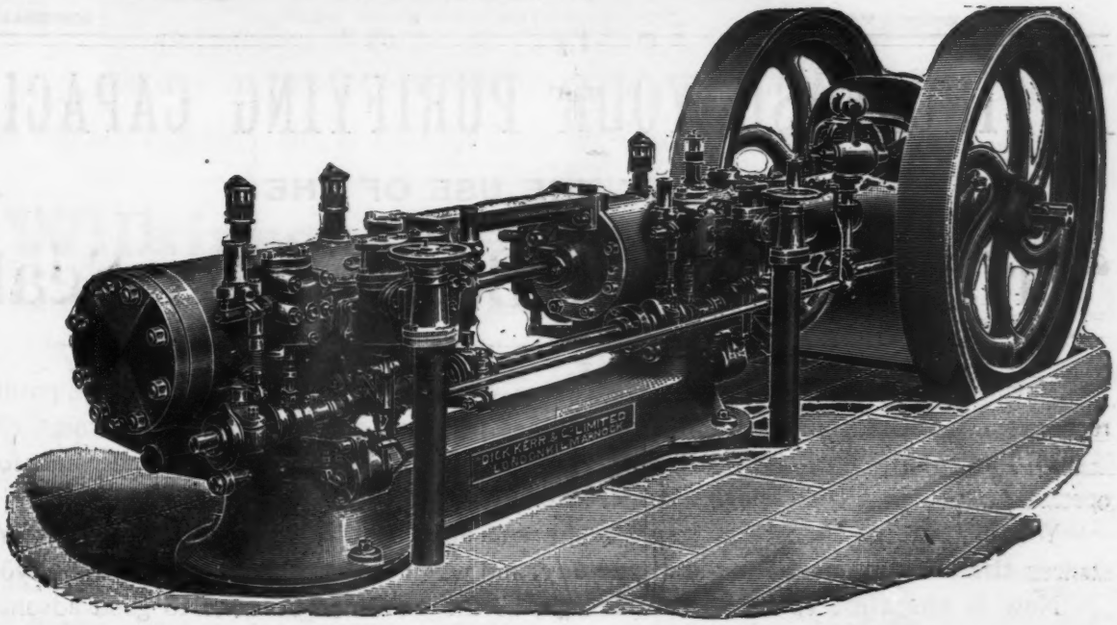

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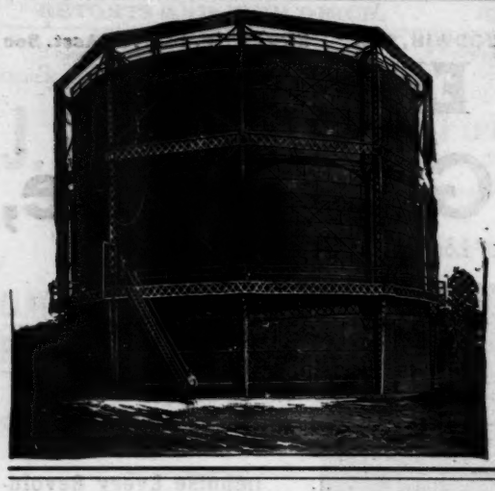

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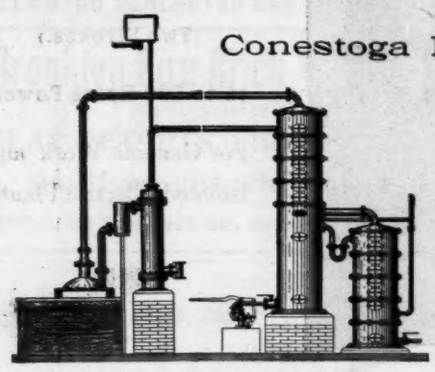

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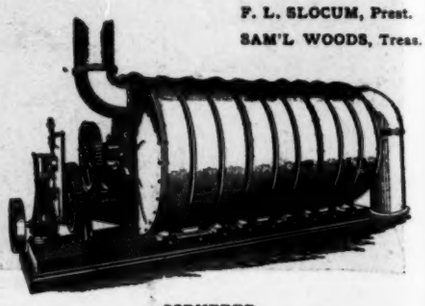

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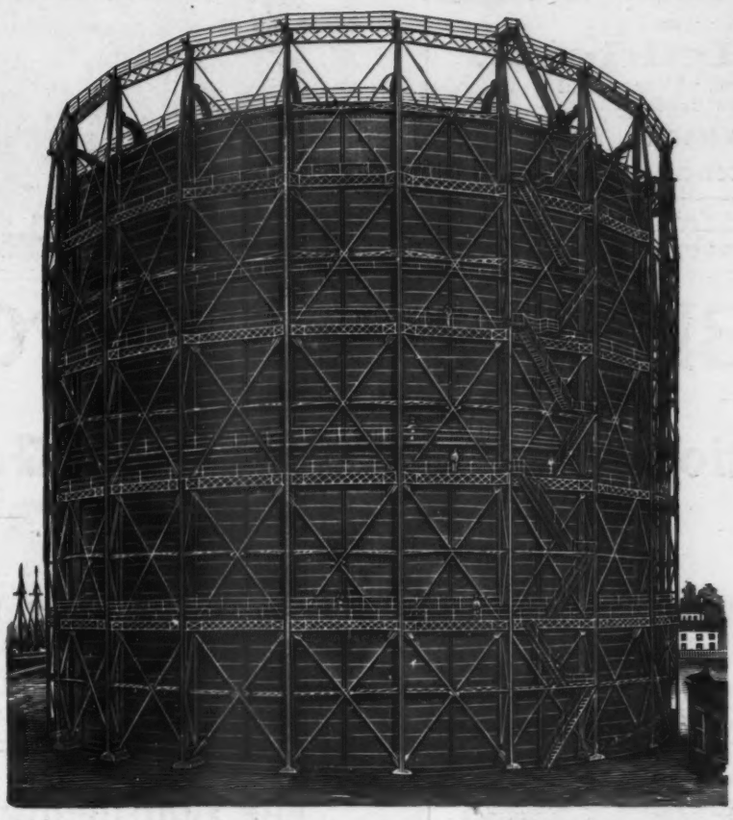

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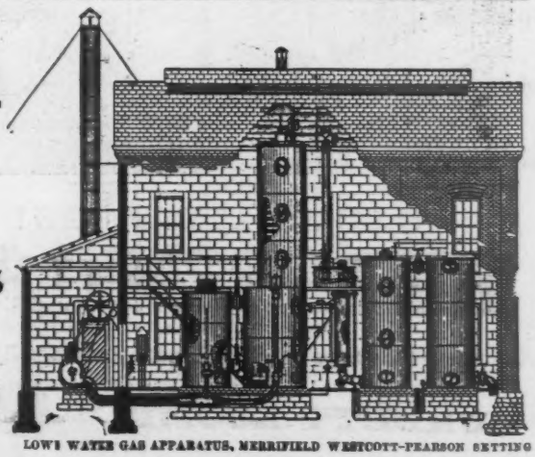

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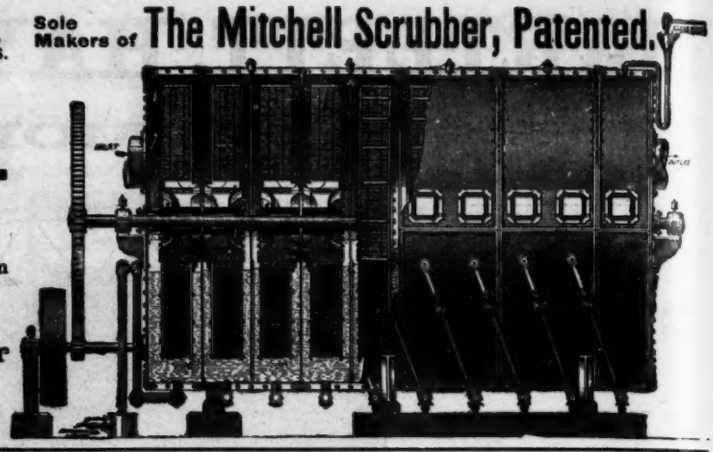

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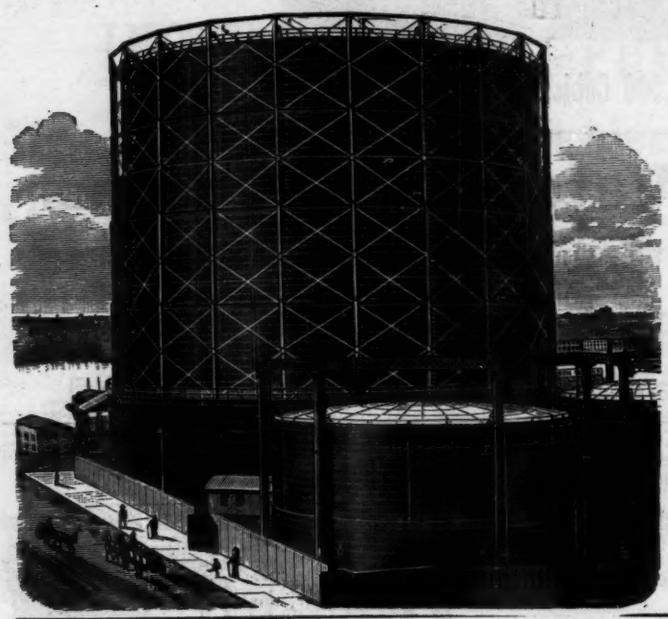

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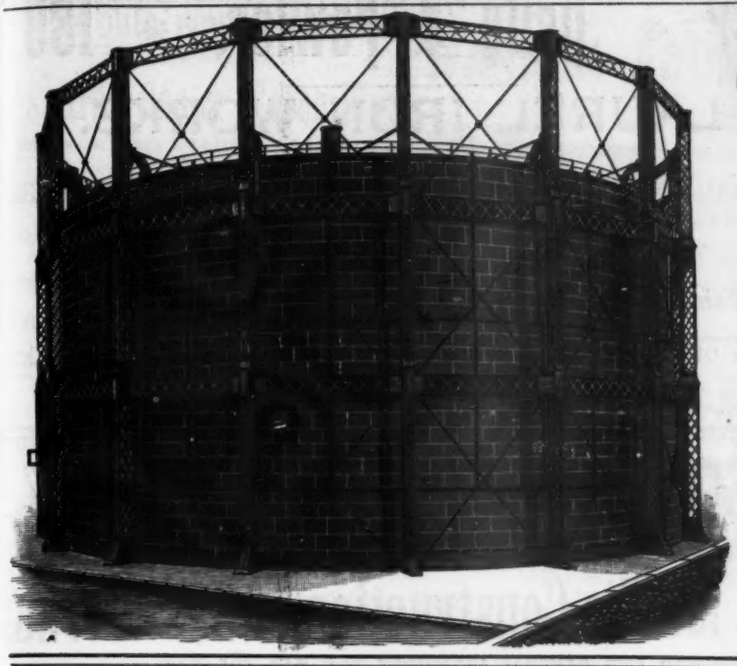

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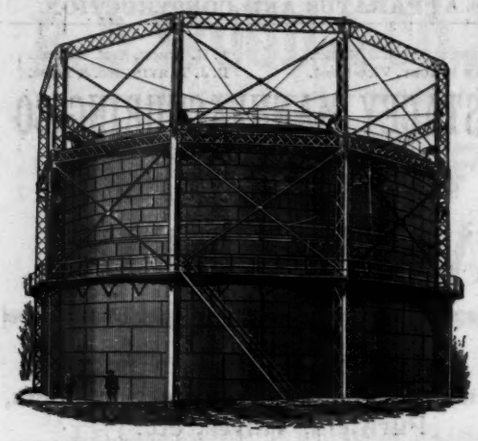

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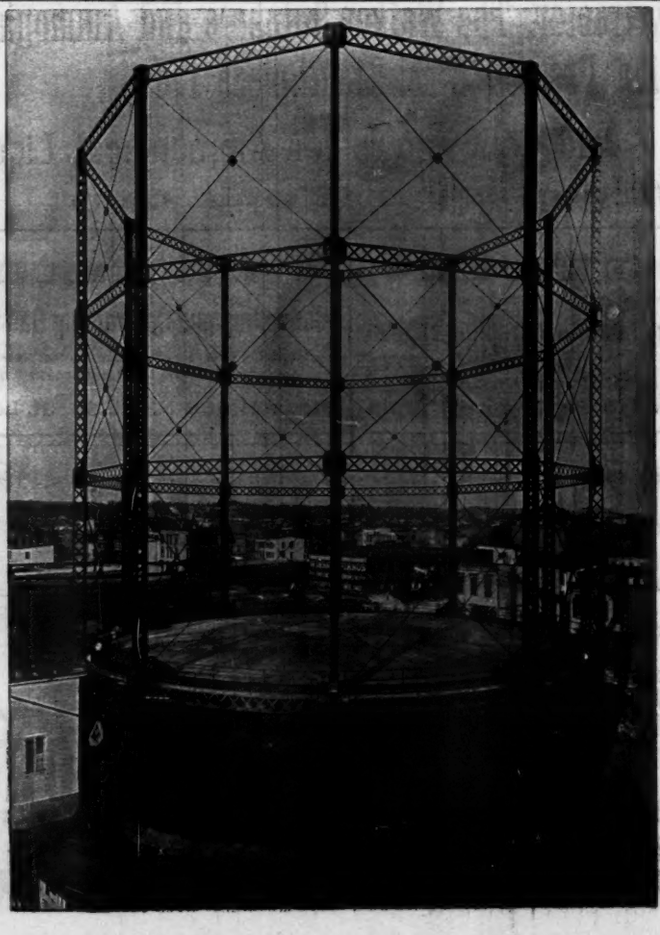

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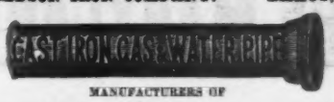

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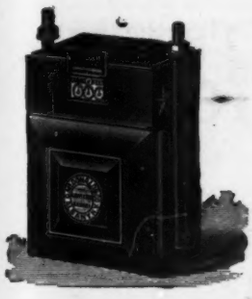

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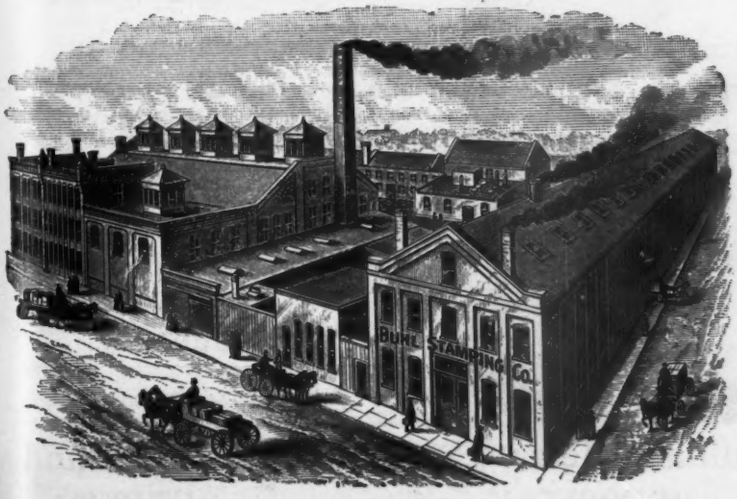

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